DRUM *and* CROAKER

A Highly Irregular Journal for the Public Aquarist

Volume 44 *Jan. 2013*

TABLE OF CONTENTS
Volume 44, 2013

Cover Photo: J. C. Delbeek.

DRUM AND CROAKER 50 YEARS AGO

(Excerpts from the 1963 issue – Current editor's notes in brackets)

An informal, irresponsible, unedited unexpurgated, self-styled voice of the Professional American Aquarist and the Aquarium Research Science Endeavor. Conceived in sinful New Orleans in 1957 and baptized by total immersion in bourbon and scotch in a solemn ceremony held in a smoke filled room, the D & C has grown from a humble proposal for an aquarist's journal to be called the "Grunt and Crappie" to its current position of strength as a meager light in the dark ocean of aquatic science.

Construction News:

The National Aquarium *[Washington, DC Project]* is now under way officially with an advisory committee complete except for one name. Athelstan Spilhaus, Dean, "School of Engineering of University of Minnesota is chairman. No aquarist yet appointed to this advisory committee.

Construction of a marine exhibit addition to the Dallas Aquarium *[Children's Aquarium at Fairpark]* is under way. *[also see page 4 in 2013 issue]*

The first stage of construction *[of Sea Life Hawaii]* has been completed at the majestic site at Kaupo Park on the island of Oahu. It is a mammal training facility that will service both the display park and its associated nonprofit research center. The entire park, which is located on a 118 acre site, faces the sea with abrupt 1000 foot lava cliffs on one side and coral pocket beaches on the other. The entire project is unique amongst existing oceanaria in that it is a non-profit venture dedicated to the advancement of knowledge of the sea. The parent organization, the Oceanics Foundation, will oversee both the exhibit park and the adjacent Pacific Oceanics Institute. The latter organization will utilize the unparalleled water supply which will be pumped at nearly 5 times the rate of any existing facility. It will include both surface and deep sea experimental facilities, and associated structures for the-use of industry and academic institutions. Already, Taylor Pryor, President of the Foundation, has unique exhibit animals in training. They are spinner porpoises, and of the four thus far taken, one is a partial albino named Haoli (which means "white man" in Hawaiian), --- Ken Norris

Recent Presentations and Publications:

Ideal Configurations for a Semi-Closed Circulating Aquarium System.
William E. Kelley, Cleveland Aquarium

A set of values for the various design considerations of a semi-closed circulating aquarium is offered wherein:

1. The ratio of water volume to living animal weight is one hundred gallons to one pound.
2. The turnover rate of the system through the filter is once per hour.
3. The ratio of filtrant volume to animal weight is one cubic foot to one pound.
4. The flow rate through the filtrant is one gallon per square foot of surface area per minute.
5. The filtrant consists of two to five mm. grains of silica gravel in fresh water systems*

6. The filtrant consists of 75% silica gravel of two to five mm. grains and 25% calcareous gravel of two to five mm. grains in sea water systems*

These design parameters are discussed critically with respect to ammonia and carbon dioxide as the chief limiting factors in aquatic animal culture.

Tuberculosis of Fishes and Other Cold-Blooded Vertebrates with Special Reference to Mycobacterium Fortuitum from Fish and Human Lesions.
Ross F. Nigrelli and Henry Vogel, New York Aquarium and Bureau of Laboratories, New York City Department of Health

A survey of fishes in the New York Aquarium, and search of the literature, shows that tuberculosis in cold-blooded vertebrates is more prevalent than may be suspected. The disease was reported in more than 140 species of fishes, 12 species of amphibians and 12 species of reptiles. Tuberculosis was found in more than 30 species of fishes, especially in tropical freshwater forms of the families Characidae, Cyprinidae and Poeciliidae. Of special interest is the discovery that the acid-fast bacillus isolated from the Neon Tetra, *Hyphessobrycon innesi*. is identical with *Mycobacterium fortuitum*, a species originally isolated from human lesions in South America. In stenohaline fishes in the Aquarium tuberculosis commonly occurs in clownfishes (Pomacentridae), inhabitants of Pacific coral reefs.

[Hinton, Sam 1962. Longevity of Fishes in Captivity, as of September, 1956 Zoologica, Vol. 47, part 2, no. 9, pp. 105–116, Scripps Institution of Oceanography.]

Sam's long awaited survey of the longevity of fishes in captivity has at last appeared --- In it, he lists 307 species that have lived five years or more in captivity. The oldest fish was a sturgeon kept for nearly 70 years in the Amsterdam aquarium --- which, incidentally, posted the greatest number of records: 95 different species, most of them tropical, freshwater forms.

THE METAMORPHOSIS OF THE DALLAS AQUARIUM AT FAIR PARK INTO THE CHILDREN'S AQUARIUM AT FAIR PARK, WITH HISTORICAL ANNOTATIONS

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Authors note: numbers bracketed and in superscript correspond to end notes following the article. These are mostly items of historical interest that are presented separately so as not to distract from the main focus, but these eccentricities seemed appropriate for D&C.

In the early days of this journal the pages regularly contained updates from around the aquarium world on new exhibits, new animals, and construction of new facilities. It's certainly a much bigger community now than at the inception of D&C, but as a nod to those communiqués of days past we present here a report on the overhaul and renovation of the Dallas Aquarium at Fair Park, re-opening as the Children's Aquarium at Fair Park in late 2010. This follows in the tradition of Moore (1965), who wrote up a summary of the last major renovation of this facility, a marine wing, which opened in 1964. This article also serves to note another milestone in the history of the facility; in 2011 the facility celebrated its 75th anniversary[1].

The facility opened in 1936 as part of the Texas Centennial celebration, and has been open to the public ever since (except during major construction from 1963-64 and 2009-10). The facility's exterior was originally patterned after the 1933 Seattle Art Museum (Now the Seattle Museum of Asian Art), and the service areas and exhibits were modeled on those of the 1930 John G. Shedd Aquarium. The original layout contained many elements of contemporary aquarium design from the period such as square concrete tanks lining the exhibit hall, a handrail in front of the viewing windows, arched ceilings, skylights for tank illumination, et cetera[2]. The building's exterior contains elements of art deco architecture including numerous bas-relief carvings of sea life. The 1963 renovation as described by Moore (1965) added 68 feet of exhibit hall onto the north end of the building, and made the facility the third largest aquarium in the U.S. at the time.

By 2009 the aquarium was in dire need of an overhaul. Decades of wear and lack of maintenance had taken its toll, and to many it seemed the facility was beyond the point of salvage. The roof[3] had numerous leaks, the walls were crumbling, the skylights were broken and rust-covered, rusting rebar was exposed everywhere, the ceiling in the public area of the 1963 saltwater wing had collapsed, many of the concrete tanks were no longer structurally sound, and a thick maze of abandoned rusting pipes and electrical conduit seemed to be everywhere. These fundamental issues with the building had led to the loss of AZA accreditation in 2001, and nearly led to the closing of the facility on more than one occasion

since. In 2003 and 2006 the voters of the City of Dallas approved bond funding totaling 8.2 million dollars for renovations to save the aging facility.

With a handful of exceptions, the animal collection was completely dispositioned in 2009; 29 other zoos and aquaria across the country received a total of 2,244 individual animals (plus or minus several hundred…we didn't exactly count all the cichlids). A total of 143 styros were packed and shipped via Fed-Ex, UPS, DHL, and air cargo. Twenty six large crates (coolers/super-shippers) were packed and shipped, and 17 ground transports[4] were made by our staff and by personnel from visiting facilities. Approximately a thousand emails, 45 health certificates, and over 20 cases of beer later the surplus was complete. The building was now ready for demolition to begin.

The renovation commenced with a stripping out of all the old piping, electrical conduit, light fixtures, ductwork, and a myriad of pipe hangers, hose reels, coat hooks and other hardware that had been bolted to the walls, ceiling and floors over the years. Walls and concrete columns were repaired as needed, the floor was reinforced with steel, and it seems as if lead paint and asbestos were removed from pretty much everything. The building originally had a concrete reserve tank behind every exhibit tank, many of which were no longer structurally sound; these had to be removed to make way for modern LSS, though many of the staff hated to see this unique (and functional) part of aquarium history lost. The original exhibit windows were 1.5" thick plate glass held against a natural rubber gasket by a piece of beech wood anchored to the concrete wall with bronze spikes. The wood would swell when wet and keep pressure on the window. These were originally slated to be retained, but nearly all ended up being replaced by acrylic with silicone seals after desiccation of the rubber and wood caused them to fail. See Figure 1 for typical before and after views of the aquarium's service areas.

Until its closing in 2009 many of the tanks had been maintained with LSS that would have been familiar to past caretakers such as Pierre Fontaine[5], Marion Toole[6], and Jeff Moore[7] in the 1930's through the 1960's. The freshwater tanks were mostly still open-system, drawing water from the aquarium's well[8], and pumping it up to the water tower as described by Moore (1965) to gravity feed the exhibits. The predominant method of filtration in the 1963 saltwater wing was still airlift-driven under-gravel filters. A few systems had been modified along the way incorporating pumps, chillers, protein skimmers, and other modern accoutrements, but the majority of systems were decidedly 'old-school' in design[9], many using hardware and piping original to the building.

Figure 1: Three before-and-after sets of photos of service areas. Photos on left were taken 2009, photos on right taken from same vantage points in 2012. Top: freshwater wing showing concrete reserve tanks (left) and open-system tanks; after construction (right) note epoxy sealed floors and walls and LSS equipment. Middle: a section of the marine wing before and after; the back wall in both pictures denotes the line of 1936/1963 construction. Bottom: the aquarium's basement, showing the remnants of the chilled water system (left) described by Moore (1965), this was one of the first large-scale chillers ever used in a public aquarium. The area was converted to a modest quarantine area (right).

Aside from the repair of structural and electrical issues the single costliest and most labor intensive improvement in the facility has been in the upgrade of the life support systems. A consistent LSS scheme was developed and implemented across the facility so that the basic layout was the same (sand filter + biofilter), though some tanks featured additional specialized equipment based on the species they would contain and whether they were marine or freshwater (i.e. protein skimmers, UV sterilizers, heat exchangers, et cetera). All of the equipment was brand new, and more importantly, it was all uniform. The menagerie of salty, corroded pumps that were in service before were banished to the blackest pits of hell and for the first time since the original opening everything matches!

I doubt Fontaine or Moore would have ever dreamed that the tanks here at the little old aquarium in Fair Park would one day be controlled by a computer that would send a text message to your phone at 3:00am when the flow drops or temperature rises above setpoint[10]. The ability to log in and manipulate flow rates, oxygen saturation, or other factors would have been likewise inconceivable, but these advances are part of a greater tradition of technology applied to fishkeeping that has always existed here. When the facility originally opened the water chilling systems were the absolute cutting edge in temperature control, and had never before been used on this scale in an aquarium[11]. During the 1963 renovation the facility ventured far off the beaten path in utilizing the new-fangled "Instant Ocean", becoming one of the very first public aquariums to rely exclusively on artificial seawater (Moore, 1965; Fontaine, 1963).

The 1965 D&C article also mentioned a few new techniques that had been developed for building exhibitry, namely the use of bleached corals cemented onto "holey rock" from the Texas hill country to create reef-like habitats[12]. Many of these backgrounds were still in place and had been in continuous service since the 1960's. The earlier article mentioned that these rock and concrete creations could be "easily torn apart if needed" (Moore, 1965). Taking that statement at face value I can only assume that aquarists were made of much sturdier stock in the 1960's, as we found the disassembly of these rockwork structures to be near impossible! We broke 3 sledgehammers and went through a number of chisels in the attempt to gut the old concrete tanks to their bare walls. As a nod to all those who have worked here before us (and because we ran out of time and chisels), we left three of these structures intact. All of the other exhibits were completely stripped of the old rockwork and re-done, Figure 3 shows a side-by-side comparison of the tanks Moore described under construction in 1963 and today.

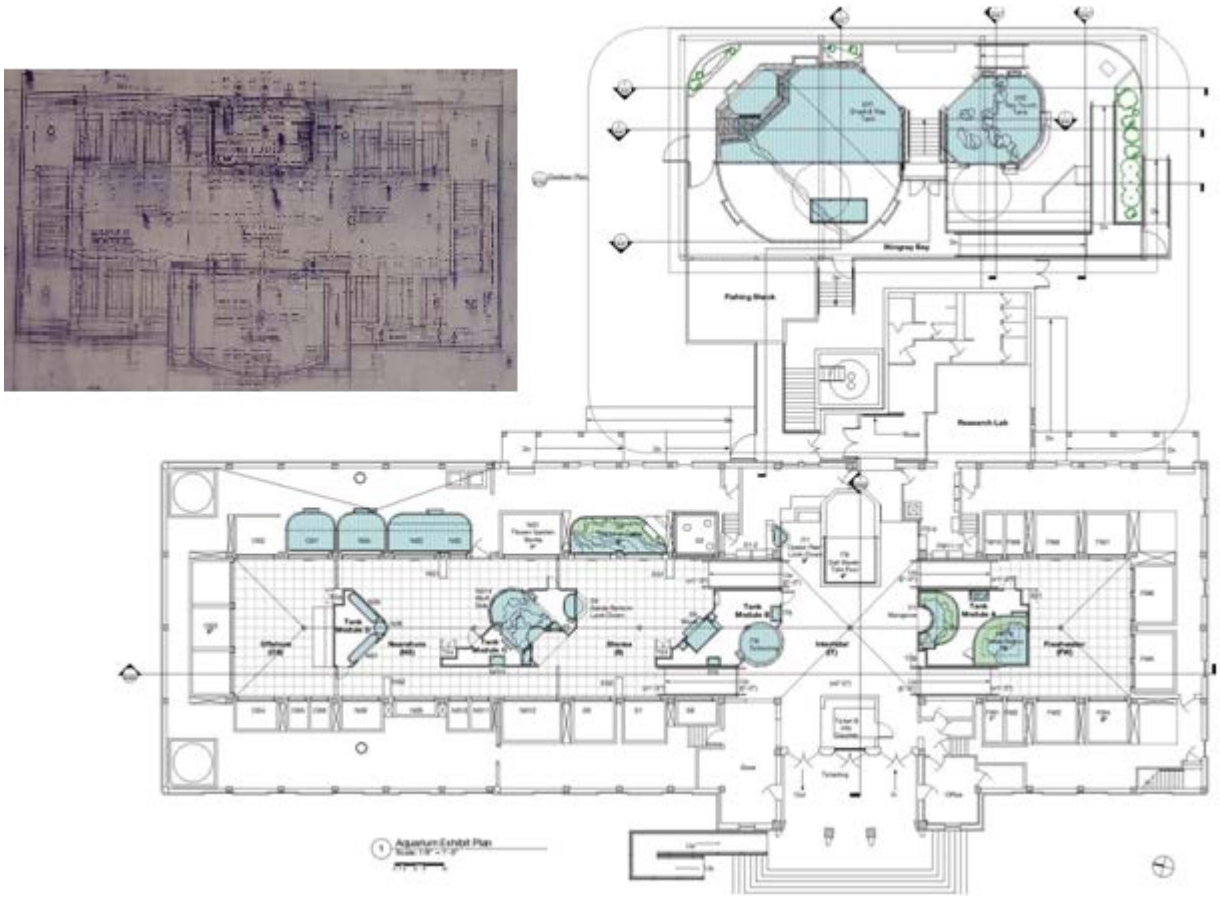

Figure 2: A floor-plan and overview of the 2009-2010 renovation. All tanks featured in color are new additions to the building, including the Stingray Bay addition at the top of the drawing. Inset shows original 1936 building configuration (microfilm was badly degraded). Drawing by Halff and Assoc. (Dallas, TX), and Lyons-Zaremba (Boston, MA).

Figure 3: The concrete tanks that had limestone and bleached coral inserts to create reef habitats as described by Moore (1965). Photo at left shows the tanks (and the marine wing itself) under construction in 1963, photo at right shows the same tanks in operation today. Photo on the right by Jeff W. Moore.

We also turned lemons into lemonade in the repurposing of a 10,000gallon Amazon exhibit that had catastrophically failed in 2007[13]. The tank was approximately 8 feet deep, and the front viewing panel burst 5 minutes before opening one Saturday morning (no staff were injured and amazingly only one fish was lost in the event). The acrylic edge was cut down and beveled over, and decorative rockwork was added inside and out to turn the tank into a coastal touch tank featuring a diversity of invertebrates (Fig. 4).

Figure 4: The aquarium's invertebrate touch tank in 2007 (left) and 2010 (right). The tank was originally a 10,000 gallon Amazon exhibit that experienced a "technical fault in the operating device", or as we say in south Dallas, "it blew the &@!# up". The tank was remodeled into a touch pool making use of the existing concrete base and approximately 8" of the original acrylic. Photo (left) by Eric Julius.

In addition to the overhaul of existing tanks, a number of new tanks and exhibits were also added to the facility (Fig. 2). The original design of the aquarium structured the facility as a long hallway with no real galleries. In order to add new exhibits and create a sense that children can "wander" and explore we added four geometrically irregular 'modules' (islands) in the center of the lobby (Fig. 5). These modules help break up the line of sight so that visitors cannot see from one end of the lobby to the other, and allow for kid-friendly graphics and colors that would not be permitted on the walls of the facility proper due to the building's status as a historic landmark. These modules replaced the "lobby house" which was a rectangular center island of plywood and 2x4 construction housing up to 30 glass tanks[14]. The lobby house had served its purpose well, but after more than 20 years of continuous service was dilapidated and in need of replacement. With removal of the handrail and the lobby house, the floor could be raised 18" to allow kids to get right up to the viewing windows of the tanks. These changes, coupled with the modules and their graphics substantially transform the interior of the aquarium, while still preserving most of the original tank layout.

Figure 5: Three before-and-after sets of lobby photographs. Photos on left were taken 2009, photos on right taken from same vantage points in 2012. Top: The freshwater wing during construction (left) and after re-opening (right) showing Module A which contains freshwater and intertidal exhibits. Middle: looking down the marine wing in 2009 (left) and after renovations (right) showing Module B with a schooling exhibit and a number of jewel tanks. The bottom pictures show a view of the marine wing where the 1963 addition starts before (left) and after (right) showing Module C which features a split GPO/kelp forest tank and several jewels. Note the light green Carerra glass at the bottom of the walls that encircles the entire lobby.

The modules and life support upgrades were not the only new features of this renovation. An outdoor pavilion (Fig. 2,6) was also added onto the facility featuring a 58,000 gallon shark exhibit and a 8500 gallon stingray touch pool that has proven to be the most popular exhibit the aquarium has featured. The outdoor exhibit (unimaginatively) came to be called Stingray Bay[15], and can join the legion of similarly named exhibits that seem to have proliferated in recent years.

Figure 6: The Stingray Bay addition, a semi-enclosed outdoor pavilion featuring a 58,000 gallon shark tank and a stingray touch pool. Photo at left shows completed exhibit in 2011, conceptual drawing at bottom right shows an aerial view of the exhibit as it was planned. Stingray touch tank shown at top right. Conceptual drawing by Lyons-Zaremba, Boston, MA.

The aquarium contained 152,000 gallons before renovation[16] and 24, 367 square feet in area. After construction the aquarium total volume is 235,000 gallons and 29, 354 square feet. All of the additional area is comprised of exhibit space open to the public. The new-and improved aquarium re-opened in September 2010 (Fig. 7).

The general theme of the new aquarium (Fig 2) grouped tanks together loosely into galleries and ordered them so that they generally followed the path of a river to the sea. From

the south end of the building visitors transition from freshwater to an intertidal/shore area featuring the invertebrate touch tank. The marine wing of the building features exhibits housing near-shore animals and transitions to offshore exhibits. The exhibits are a compendium of themes most popular to visitors (alligators, seahorses, et cetera), but also highlight nearby habitats such as the Trinity river, Flower Garden Banks National Marine Sanctuary, offshore Gulf of Mexico oil rigs, and Mexican ciénegas, among others.

The Dallas Aquarium/Children's Aquarium at Fair Park has seen many changes in the world of aquarium-keeping in 75 years. Much bigger facilities have opened with grander exhibits and spectacular animals, and husbandry of species thought impossible to maintain in glass boxes in 1936 is not just possible, but routine. Sharks, corals, and seahorses are not the odd rarity occasionally featured, but mainstays of the modern aquaria. In days gone by aquarium husbandry as we now know it was not just practiced, but developed here by masters of the art and science of aquarium keeping. At one point it seemed this venerable old aquarium would forever close its doors; but now overhauled and with new purpose this facility will continue to educate, entertain, and hopefully inspire the public for many years to come.

Figure 7: The completed aquarium on the eve of the grand re-opening in 2010. Photo by Cathy Burkey, Dallas Zoo

Acknowledgements:

This article is dedicated to the collective staff, past and present, of the Dallas Aquarium and Children's Aquarium at Fair Park for seventy-six years of service and dedication.

Annotations of Historical Interest:

1) The aquarium turned 75 in 2011; but 2013 marks the 100th anniversary of fish display at the State Fair of Texas – the current aquarium building was preceded by the State Fish Hatchery at Fair Park from 1913-1935. The facility was a working small scale hatchery but also focused on public display and education. The hatchery was a pet project of noted fish fancier and head of the Texas Fish, Game, and Oyster Commission, Colonel William G. Sterrett. The current building was nearly named the Sterrett Aquarium in his honor but ultimately the facility was named the Dallas Aquarium for its grand opening amid a visit from President Franklin D. Roosevelt in 1936.

2) The September '62 D&C (Finneran, 1962) contains a wealth of information on vintage aquarium design including floor plans and exhibit diagrams of most of the public aquaria at the time, including this facility.

3) Fun fact about the aquarium's roof: in 1954 a severed human leg was inexplicably found there. The desiccated leg was found by work crews and press coverage exploded. Director Pierre Fontaine, who was away on a fish-collecting trip, cleared up the incident a week later indicating that he had allowed a young aquarist to place the leg on the roof to dry after being treated with formaldehyde as part of an experimental preservation technique, and it had been forgotten. To his dying day Fontaine never publicly revealed the name of the aquarist, simply noting that he was now a "zoologist of some note" who was working in New York. The author believes that aquarist was most likely Dr. John M. Anderson of Cornell University, co-author of a landmark zoology textbook and founding faculty member of the Shoals Marine Laboratory. I find it terribly interesting that the nature of aquarists has changed little in 58 years; as I write this our current staff is gleefully conducting experiments to determine whether a certain brand of soft drink will dissolve the carcass of a mouse given sufficient exposure time. It is a very good thing none of the current staff has access to cadavers, lest we make headlines again.

4) Our animal transports in clearing out (and later re-acquiring) the animal collection had their fair share of difficulties, including airline ineptitude stranding half a dozen sharks mid-transport in Los Angeles. Such incidents are apparently part of a grander tradition: see the April 1977 issue of D&C (Hewlett, 1977) for the account of an animal transport gone horribly wrong by Dallas Aquarium alumni Gerrit Klay in accompanying a sawfish from here to Vancouver. Some things just never change…

5) Pierre Fontaine was the aquarium's first (and third) director and he went on to be director of the Dallas Zoo and serve as President of AAZPA. He never did retire, and died in 1968, still serving in those roles.

6) Marion Toole was the aquarium's first superintendent and second director. He later went on to be Director of the State Game Fish and Oyster Commission as elements of the State Parks Board and Civilian Conservation Corps were being integrated into that agency in a move that would ultimately create the Texas Parks and Wildlife Department.

7) Jeff Moore was a young aquarist when the facility opened in 1936 but was soon let go due to the pressures of the great depression and because he was the only staff member without a wife and family to support. He returned after WWII and served as Curator for over 30 years during which time he contributed a handful of D&C articles in the early days of this publication. Jeff died in 2010 a few months before the renovated facility re-opened and is buried just a couple miles from the aquarium.

8) The aquarium's well has been utilized as the main source of water since opening in 1936; the current pumps (albeit fitted with new motors) have been in continuous service since 1947!

9) The author would be remiss in failing to note that while the designs were old, they did indeed work, and worked very well. Former Curator Jeff Moore noted on the longevity of numerous species in his care at the aquarium in D&C (1963); and the current staff has kept that tradition alive (no pun intended) to the present day. When the collection was dispositioned we noted some rather aged animals including cichlids that had been here 20+ years, stonefish residing for 16 years, *Ogcocephalus* batfish for 12 years, and a *Hippocampus whitei* that had been here 6.5 years, among others. One of the two alligator gar Moore mentioned in 1963 was still alive and well when he was given a new, larger home at another institution. Another long-time denizen of the aquarium, a 195lb alligator snapping turtle, seemed less than thrilled to be moved from his tank for the first time since the early 1990's (no one was bitten, but not for lack of trying). Senior Aquarist Charles Yancey even 'found' a bumblebee cichlid hiding in one of his tanks that he thought had died in the 1980's!

10) The automated control and paging system we installed is certainly an amazing piece of technology, but not infallible. We have found that common sense and a walkthrough at the beginning and end of each workday are still the surest guard against accidents. An aquarist's ear is a finely tuned machine and often can tell that a pump bearing is failing long before flow drops and a digital wireless sensor can send a text message through the aether. In keeping with this philosophy our master control panel is festooned with a copy of the article from p.45 of the September '69 D&C hilariously illustrated by Craig Phillips (Atz, 1969). I like to think of it as a reminder that no one, man or computer, is

infallible. Almost a half-century later despite tremendous technological advances the fishes have still seen that their aquarists are indispensable.

11) The chilling systems featured two large reservoirs with convoluted heat exchangers in the attic water tower- one was chilled and one was heated, the aquarist could then precisely manipulate tank temperature in the open-system exhibits via a precarious balance of hot and cold water inputs. It was one of the first large scale aquarium chillers in the world.

12) Many of the skeletons included on the vintage 1963 rockwork were of *Acropora palmata* and *Acropora cervicornis*, two species now listed as threatened on the USESA. In recent years the institution has supported Project SECORE in the conservation of these species in the Caribbean.

13) The Amazon tank was added in 1993-1994 along with ADA compliant restrooms and a breeding laboratory for endangered salamanders and desert fishes. This construction was part of a bid to improve the decaying facility following the AAZPA tabling accreditation amid growing concerns over the condition of the building.

14) The Lobby house was added in 1988-89 to feature smaller tanks from 10-180 gallons. This provided a good balance of tank size as the vintage concrete tanks were all rather large, between 750-2250 gallons in size.

15) A non-historical note, allow me to ascend to my soapbox…my fellow aquarium and zoo people: we are, collectively, a rather intelligent and creative group of people. Can we please come up with a more original name for stingray exhibits than "Stingray Bay"? If everybody else jumped off a bridge would we do that too?

16) The facility contained 35,944 gallons in the display tanks at opening in 1936. The 1963 expansion added 4080 square feet and brought the facility over 100,000 gallons total (including reserve tanks).

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Moore, J.W. 1965. Dallas Aquarium. Drum and Croaker 65(1): 8-10

SMALL FISH FEEDING IN A 212,000 GALLON CORAL REEF EXHIBIT

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The 25 foot (7.6 m) deep, 212,000 gallon (803 m^3) Philippine Coral Reef exhibit at the Steinhart Aquarium in the California Academy of Sciences is populated by many species of small planktivorous fishes including groups of purple queen anthias (*Pseudanthias tuka*), shrimpfish (*Aeoliscus strigatus*), garden eels (*Heteroconger hassi*). Getting food to all of these smaller fish is difficult because 100-200 large fishes, mostly fusiliers (*Caesio* and *Pterocaesio* sp.) and surgeonfish (Acanthuridae), eat most of the food fed from the top of the exhibit before smaller fish can partake. A two-pronged approach was instituted in early 2012 to make sure all the fish on exhibit were getting appropriate amounts of food – an auto feeding system to deliver planktonic fish and coral foods throughout the day, and an injection feeding system on the exhibit's closed loop circulation system zones for small and medium sized fish feeds. So far, both systems are working well by delivering food to all areas of the exhibit as well as eliciting naturalistic behaviors that directly enhance the guest experience (photo 1).

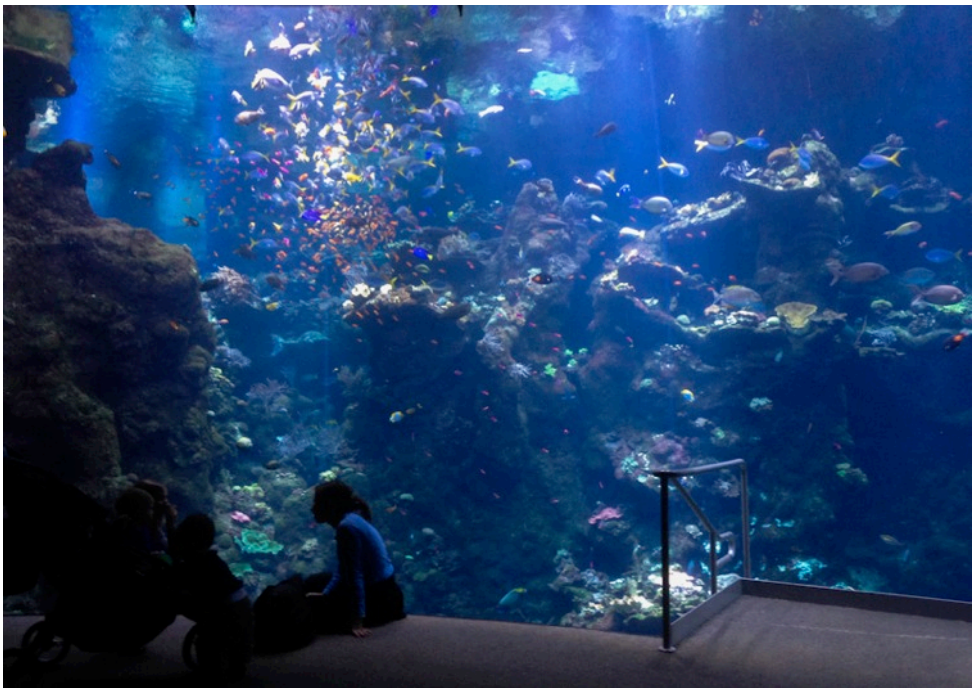

Photo 1: Display fish shoaling and feeding in the current where food is entering the exhibit. Photo –R. Ross

Auto Feeding

To accomplish the goal of allowing the smaller fish to be eating zooplankton throughout the day like they do in nature, we installed an auto feeder to dispense planktonic foods (48 hour *Artemia*, Cyclopeeze®, fish eggs, rotifers, shredded clam, etc.) at the top of the exhibit. Since the top of the exhibit is viewable by the public, all associated equipment was installed inside a teak chest.

Four "Rola-Chem" 32 gallon/day peristaltic pumps (www1) were installed to distribute food to four locations around the exhibit drawing from a 7 gallon cone bottom reservoir; an air pump was installed to keep the food in suspension (Photo 2). A small centrifugal pump was installed in the exhibit and a line run to the reservoir so after adding the wet planktonic food slurry, the reservoir can be filled with clean tank water at the flip of a switch. Polyethylene tubing (0.25"/6.4 mm) was run from the peristaltic pumps into four entry points around the top edges of the exhibit in areas of fast flow to further distribute the foods – the longest run of tubing is approximately 60 feet (18.3 m).

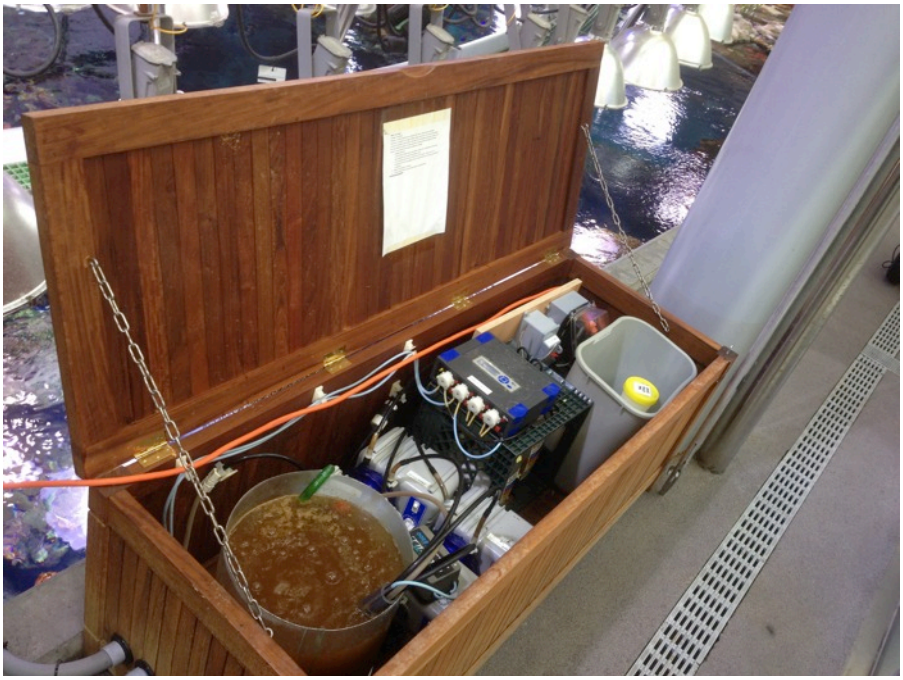

Photo 2: The chest above the exhibit holds the wet feed reservoir, the 4 peristaltic pumps, trace elements and doser, electrical switches and a container to hold foods that are fed during presentations. Photo R. Ross

When food is delivered to each entry point fishes in the tank orient themselves into the flow and actively and naturalistically feed, though the larger fish seem to be hoping that food big enough for them to eat will come through. Besides actually getting food to the smaller fish throughout the day, this cloud of fish fanning out into the flow and actively feeding greatly enhances the guest experience of the exhibit.

The polyethylene lines from the peristaltic pumps will bio-foul over time so they are flushed monthly with dechlorinated water. Once a quarter, the lines are filled with 5% acetic acid, allowed to sit overnight, then flushed with fresh water (the little bit of vinegar going into the exhibit via this process is negligible). If a line clogs to the point where it cannot be cleared, the line is replaced.

Injection feeding

As part of the water movement of the exhibit we have three 40 HP Fybroc® pumps that supply water to five 12 inch (30.5 cm) PVC pipe "zones". Each of these five zones has an actuated butterfly valve; the volume of water that is moved through each zone is computer controlled and changes throughout the day. Existing 1 inch (2.5 cm) valves on each of the zone pipes seemed like perfect areas to inject food and let it travel to various parts of the exhibit. A large basket strainer housing, without the strainer, is used as a reservoir for the food to be injected. An Iwaki MD100-RLT pump is used to inject the food from the basket into the zones. The Iwaki pump draws water from Zone C, B or D and pumps the food to Zones A and E. (fig. 1 and photo 3).

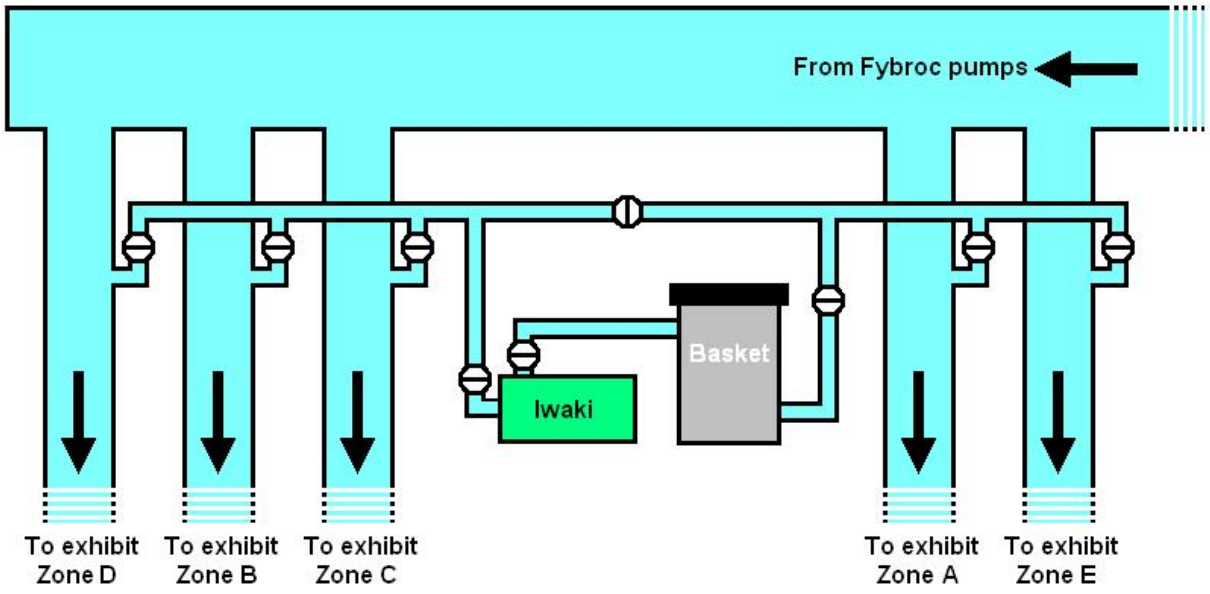

Figure 1: Diagram of Zone Injection Feeding System. Diagram M. Wandell

Foods injected daily include Hikari® Bio-Pure® frozen Mysis, Piscine Energetics PE Mysis, pacifica krill, superba krill, and various flake and pellet foods. The basket strainer has a valve at the bottom that leads straight to a floor drain, so the left over water in the vessel can be removed after the food has been injected.

Currently we inject food into two zones: one that enters the exhibit on the top and bottom of the main window, and another that enters the exhibit at various places spread around the exhibit. This feeding method fills the water column with food at all levels of the exhibit allowing less assertive fishes access to food they would otherwise be missing with a top feeding strategy.

Photo 3: The zone injection feeding system between the closed loop zones waiting for final plumbing and electrical work. Photo R. Ross

It should be noted that initially we used a 30 gallon (114 L) reservoir, visible under the basket strainer in Photo 1, which was filled via any of the zones, food was added to the basket strainer, and then a strong sump pump was used to inject the food into any of the zones. While we liked the practicality of being able to feed all of the zones, the reality of the long time it took to pump the food out and the amount of food that remained in the basket strainer due to the backpressure on the sump pump led us to abandon this approach. The system currently in place, as described above, is easy to clean, injects all the food into the closed loop system in minutes into Zone A and E which distributes the food throughout the exhibit. .

Conclusion

The original vision for the Steinhart's Philippine coral reef was to recreate an actual living coral reef replete with a fish population representative of an actual coral reef. This meant that the majority of the fishes on display would be less than 6 inches (15 cm) and would be mid-water plankton feeders, in contrast to most coral reef exhibits in public aquariums that consist of artificial corals and larger species such as pomacanthid angelfish, grunts, batfish, snappers etc. It was quickly realized that providing enough food to several hundred small planktivorous fish was becoming a challenge. By utilizing the two methods described in this paper, the Steinhart team has been able to provide food in sufficient quantity to various regions of the exhibit, ensuring that enough food is available to all size ranges of fish. We hope these methods will inspire and stimulate others to develop similar systems.

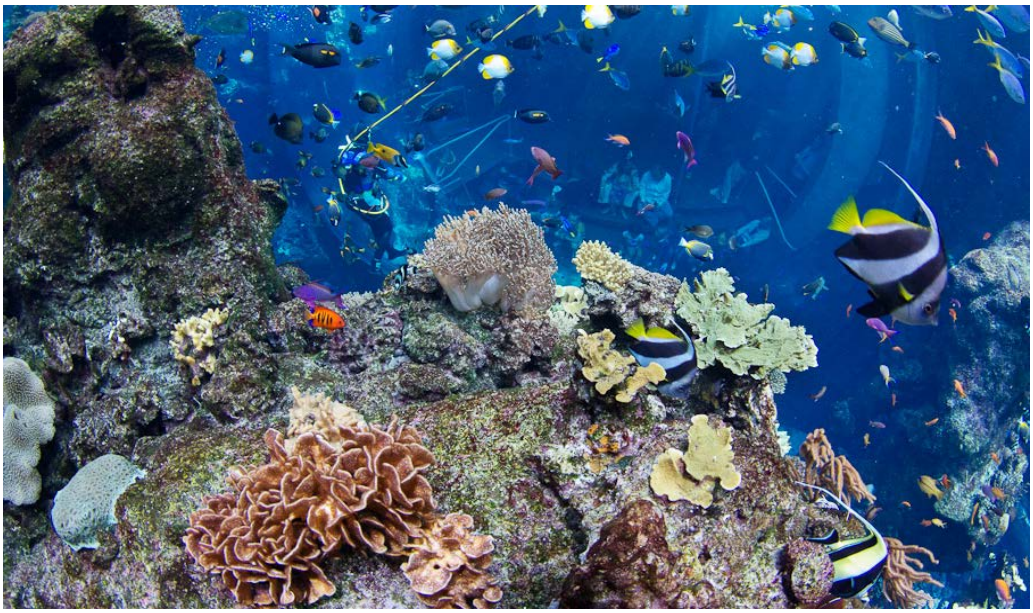

Photo 4: One small section of the Steinhart's Philippine coral reef exhibit. Photo B. Shepherd

Photo 5: View from the smaller window. Photo J. C. Delbeek

Acknowledgements

The authors would like to thank Seth Wolters, Marisa Avila, Nick Yim, Bart Shepherd, and Brenda Melton of the Steinhart Aquarium, as well as the engineering department for their assistance with and support of these projects, providing images and for proofreading this manuscript.

Internet Reference

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AQUARIUM CLEANING USING MELAMINE FOAM PADS

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Introduction

Cleaning tank windows and plastic backdrops of algae is a daily task and anything that can make it easier, well, makes it easier. One of the best tools we are using at the Steinhart Aquarium for this purpose is melamine foam, sold by Mr. Clean® under the retail name Magic Eraser®. Pads of melamine foam should only be used on non-rough surfaces like acrylic and the smooth side of plastic backdrops, but they are safe for use in aquatic exhibits. The "magic" part of melamine foam is that it can clean very fine scratches in acrylic better than traditional scrub pads because of its hard yet porous micro-structure. Cleaning smooth surfaces is pretty much the extent of their usefulness. Using them to clean things like rocks, driftwood, tubeworms or calcareous algae won't work very well and will cause them to rip apart.

How it works

Melamine foam is a foam-like material consisting of a formaldehyde-melamine-sodium bisulfite copolymer made by BASF under the names “Basotect® W” and “Basotect® V 3012” (BASF). It has a wide variety of uses owing to its high chemical resistance, high sound absorption, and flame retardant properties. On a small scale the structure of melamine foam is a very porous web of hard fibers, but it feels soft to the touch (fig. 1). Despite the scary sounding chemistry of melamine foam, it is chemically inert in seawater and does not release any problematic chemicals that we are aware of or have observed after using the pads for several years in live coral exhibits.

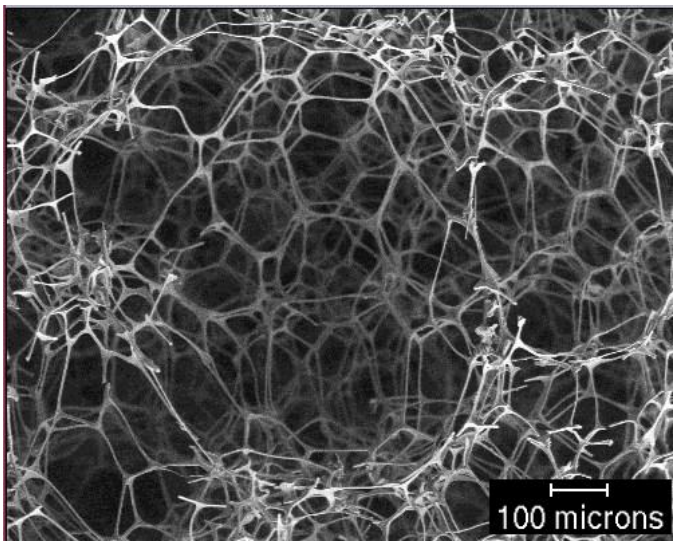


Figure 1: Melamine foam at high magnification.

We have used melamine foam pads in several different ways. The simplest way is to use the pad by hand for cleaning small exhibits. For larger exhibits, the pad can be attached to algae scrapers, Doodlebug™ heads, or cleaning magnets. To attach the pad to an algae scraper, we often bend the pad around a length of vinyl tubing and use a rubber band to hold it in place – although some keepers prefer to leave the plastic scraper blade in place under the magic eraser because it allows for a bit of extra leverage in deeper exhibits (fig. 2). To maximize the life of each magic eraser is important to bend, rather than fold, the pad when possible because it will tear easily at the crease.

Figure 2: Magic Erasers can easily be attached to a long handed scraper via a rubber band.

For Doodlebug™ heads and cleaning magnets, the melamine foam needs a backing that will mate with Velcro®. Melamine foam is too dense to stick to Velcro® on its own. Attempts to DIY a solution to this problem using super glue and adhesive tape met with failure; fortunately there is an off the shelf solution available from www.spongeoutlet.com that has a brown scrub pad bonded to melamine foam (fig. 3). The brown pad will attach to Velcro® and Doodlebug™ heads. If the pad is too thick to allow useful magnetic attraction though the tank window, removing foam carefully with a fillet knife can reduce the thickness of the foam. It should be noted that the brown pad will scratch acrylic badly, so if you reduce the thickness of the foam

pay special attention to the possibility of the brown pad wearing through the magic eraser foam over time.

Regardless of how they are utilized, all melamine foams will slowly degrade over time and become thinner, but they are still useful. At a cost of 25 cents per pad they can be considered disposable, but we have found useful lifespans up to several months if they are taken care of properly.

Figure 3: Part DBG60PK from spongeoutlet.com fits doodlebug heads and will attach to the Velcro backing of cleaning magnets.

Other considerations

Using dry melamine foam on dry acrylic will create very fine scratches in the acrylic. A melamine foam pad should always be used underwater.

Mr. Clean® brand Magic Erasers® are sold in 4 varieties: "Original", "Extra Power", "Kitchen Scrubber", and "Bath Scrubber". "Original" and "Extra Power" are 100% melamine foam, with "Extra Power" being made of denser and more durable foam; both of these varieties are entirely safe for use in all aquariums including those with live corals. "Kitchen Scrubber" and "Bath Scrubber" are melamine foam pads impregnated with cleaning detergents, which makes them unsuitable for usage in aquariums.

Resources

Mr. Clean Magic Eraser information:
http://www.mrclean.com/en_US/magic-eraser.do

Source for generic melamine foam products:
http://www.spongeoutlet.com

BASF Basotect information:
http://www.plasticsportal.net/wa/plasticsEU/portal/show/content/products/foams/basotect

Reef Builders blog about melamine foam usage:
http://reefbuilders.com/2009/03/03/magic-eraser-clean/

A UNIQUE PROGRAM FOR ASPIRING AQUARISTS

Christina J. Slager, Director of Animal Care and Exhibits

Aquarium of the Bay, San Francisco, CA

Bruce Koike, Interim President and Chris Spaulding, Aquarium Science Program Director

Oregon Coast Community College, 400 SE College Way, Newport, OR 97366

Just where do aquarists come from? The general public knows that zoo animals are cared for by zoo keepers, but when the question arises "Who takes care of the fish in a public aquarium," the answer is vague. A not unusual response is "Hmmm, I guess those animals do need someone. Maybe a fish keeper?" And, even more uncertain, if you're an aspiring aquarist, where do you go to learn the uncommon art of fish keeping?

Since the 1970's when Moorpark College began its zookeeper training program, want-to-be zookeepers have had formal training options. But how did aspiring aquatic animal caregivers— or future *aquarists*—gain the knowledge and skills to successfully enter the aquarium husbandry profession? Historically, new hires (including husbandry volunteers) learned through intensive on-the-job training that usually started at ground zero. And frequently, after 5 months of a 6 month probationary period, the trainee would announce that the job wasn't what they expected, and by the way, they're giving their two-week notice. This inefficient process was frustrating for managers and employees alike.

Upon returning from a fish collecting trip, students prepare to treat the newly collected specimens prior to placement in a holding system.

Now, there's a special program that is developing the next generation of aquarists by providing focused training in the knowledge and skills to become a pre-trained aquarist. In 2003, with a $723,000 grant award from the National Science Foundation-Division of

Undergraduate Education, the Oregon Coast Community College (OCCC) in Newport, Oregon developed and instituted the Aquarium Science Program (AQS). OCCC offers the nation's only Aquarium Science Program that grants both a Certificate of Completion and an Associates of Applied Science degree in Aquarium Science. Public aquariums are the major employers of program graduates, but students are also working at state fish hatcheries, aquarium service businesses, research facilities, and fish retail stores. Remarkably, placement of graduates is approximately 90% within six months of completing their studies. The AQS has defined an employment niche and developed a curriculum that meets the needs of many aquatic animal care organizations.

In preparation for the near shore fish collecting trip, students are prepped on the use of oxygenation equipment including compressed oxygen cylinders and regulators.

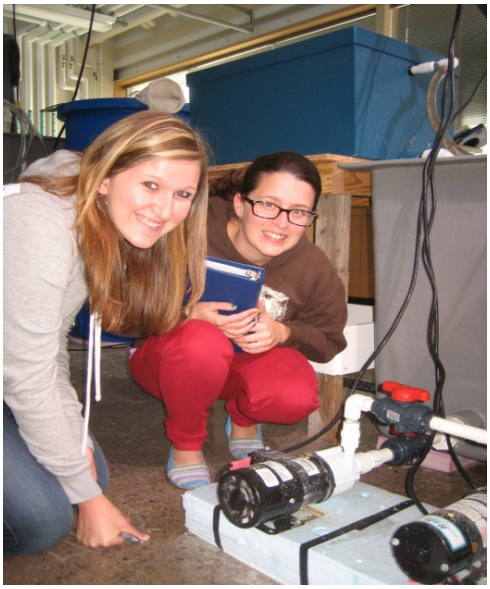
The program's curriculum includes a variety of concentrated courses that range from life support design and operations to elasmobranch biology. In a 2009 review of the program, *Advanced Aquarist Magazine* described that AQS as an "intensive, fast-paced curriculum (that) builds a foundation of applied knowledge and technical expertise that may take up to a decade to acquire through conventional means. Students are instructed on the biology and husbandry of aquarium livestock (e.g. principles of propagation, health management, etc.) as well as the design, fabrication, and maintenance of aquarium systems (principles of exhibit development, plumbing and electrical installation, etc.). The AQS curriculum takes a generalist approach, touching upon topics in all areas of aquatic animal care. In addition to formal academic classes in a traditional lecture format, students are afforded practical experience in a functional aquarium facility. To further round out its students, the program includes training in useful secondary skills such as boat handling, carpentry and SCUBA diving."

Making saltwater is another skill that students develop in the program. Working in pairs, students calculate the required amount of a particular salt, then weigh and mix the batch of saltwater.

In addition to the specialized curriculum, another striking feature of the AQS is that classes are taught in a modern, 9,200 sq. ft. aquarium science building designed to reflect the back-of-house areas of a public aquarium. This distinctive educational space opened in the summer of 2011 and was designed by gLAs Architects, LLC of Eugene, Oregon and built by Willamette Construction Group of Stayton, Oregon. Students work and learn in areas that include an animal health/water quality lab, a food prep room, a fabrication workshop, an animal holding area, a teaching lab, a live culture room, and a life support system room. Rounding out the program are interactive field trips, practicum courses and an 11-week internship. To date, AQS students have interned at many prestigious institutions including Aquarium of the Americas, Monterey Bay Aquarium, Seattle Aquarium, Stephen Birch Aquarium, Pittsburgh Zoo and Aquarium, Alaska Sea Life Center, L'Oceanogràfic, Long Beach Aquarium of the Pacific and many other facilities. These collaborators allow AQS students to accumulate at least 550 hours of hands-on, workplace-centered learning. The program is particularly indebted to its active local partners, such as the Oregon Coast Aquarium, Oregon State University's Mark O. Hatfield Marine Science Center, and Oregon Sea Grant that provide learning experiences for students.

As the AQS continues to develop students for aquatic animal husbandry careers, the aquarium and zoo community remains involved with the AQS by funding their staff's participation as part of an annual program review by the National Visiting Committee, making presentations to classes via videoconference technology, providing internship opportunities, and recruiting motivated individuals into the profession. To obtain program literature and enrollment information about the Aquarium Science Program: call (541) 867-8677 (TOPS); contact director Christopher Spaulding by email at chris.spaulding@occc.cc.or.us or bkoike@occc.cc.or.us; visit the program website at http://www.occc.cc.or.us/aquarium or mail inquiries to Aquarium Science Program, Oregon Coast Community College, 400 SE College Way, Newport, OR 97366.

The 9,200 square foot Aquarium Science building was completed during the summer of 2011. The facility offers laboratory experiences to students in the program.



Students examine life support system equipment prior to mapping out the flow of water.

As part of the Biology of Captive Fishes course, students examine the external anatomy of an albacore tuna prior to dissecting the specimen. Students enjoyed a sample of grilled tuna once the dissection and filleting was completed.

General Information for RAW 2013:

Host Institution: Georgia Aquarium, Atlanta, Georgia, USA

Where: Embassy Suites Atlanta - at Centennial Olympic Park
267 Marietta Street, Atlanta, Georgia, USA 30313
Tel: +1-404-223-2300
Booking website: http://bit.ly/TGjNxv
Rate: **$149**/night and INCLUDES full service breakfast and evening happy hour each day.

When: April 22-26, 2013. (AZA TAG MEETINGS April 22)

Tentative **Schedule for the Week:**

TAGs, AQIG meetings	April 22
General Sessions	April 23-26
Icebreaker Event (at Georgia Aquarium)	April 23 evening
Georgia Aquarium Open House & Behind the Scenes Tours	April 24 afternoon
End of Conference Social & Mixer	April 25 evening

Registration:

Before March 1st, 2013 (fee per person)
$75 Public Aquarium or Non-profit affiliate
$125 Commercial Affiliate

After March 1st, 2013 (fee per person)
$100 Public Aquarium or Non-profit affiliate
$150 Commercial Affiliate

Airport & Other Transportation Options:

- Hartsfield-Jackson International Airport (ATL) is the busiest airport in the world by passenger volume. It is an excellent hub for Delta Air Lines and Southwest/AirTran, and all major airlines service ATL. Fares should be competitive.
- Ground Transportation Options:

Mode	Cost: Airport to Hotel	Travel time: Airport to Hotel
MARTA	$2.50	25-30 min plus 1/2mi walk
Taxi	around $35	15-20min (without traffic)
Shuttle Van Services	over $25	25-45 min

RAW 2012 ABSTRACTS
Regional Aquatics Workshop, April 10 - 13
John G. Shedd Aquarium, Chicago, IL, USA

Monday, April 9
Pre-RAW AZA Conservation Group Working Meetings

Coral Reef CAP
Aquatic Invertebrate TAG
Freshwater Fishes TAG
Marine Fishes TAG
Aquatic Interest Group (AQIG)

Tuesday, April 10, Session 1.
Training

Animal Professionals

Animalprofesional.com has partnered with RAW this year to document presentations online. Attendees will have access for one year.

Target and Net Training with an Electric Eel
Lara Zamarripa
lzamarripa@aqua.org
National Aquarium Institute

Electric eels (*Electrophorus electricus)* are common at many public aquariums, including the National Aquarium, Baltimore Maryland, which houses an electric eel called Sparkay. Like all electric eels, it can be hazardous to work with and is capable of producing high voltage electric shocks that can travel throughout the exhibit. The eel also shares the common trait of near-blindness and uses the electric potential of objects to navigate. These characteristics make electric eels often difficult to feed, move for exhibit maintenance, and handle for medical procedures. Through diligent research and planning, a target was designed that allows the eel to target train using electrolocation. After target training was achieved, the eel was conditioned to curl up inside a net for transport. This paper outlines the steps used in training, as well as the pitfalls and successes of trying to work with an animal that sees the world in a completely different way than humans do.

Training of an Alligator Snapping Turtle *(Macrochelys temminckii)* and the Advantages of Training with other "Non-Traditional" Species.
Kurt Hettiger
khettiger@sheddaquarium.org
Lisa Takaki
ltakaki@sheddaquarium.org
Michelle Sattler, George Parsons, Ken Ramirez
John G. Shedd Aquarium

The training of marine mammals is fairly common at many zoos and aquariums. However, in recent years more and more aquariums have implemented training programs for a variety of "non-traditional" species including

fish, invertebrates and reptiles. Shed Aquarium has been involved in formal training of many species for several decades - however, in recent years the training has expanded to include a rehabilitated sea turtle (*Chelonia mydas)*, an alligator snapping turtle (*Macrochelys temminckii*), a Giant Pacific Octopus (*Enteroctopus dofleini*), and many others. This paper will focus on the techniques and advantages to training of one male alligator snapping turtle while also exploring some of the other training that has aided in the care of a variety of species.

Tuesday, April 10, Session 2.
Water Quality and Filtration

Sponsor Presentation – Aquatic Ecosystems

Converting Oxygen-Fed Ozone Systems to Air-Fed Ozone Systems

Andy Aiken
aaiken@aqua.org
National Aquarium
John Gaudaur
gaudaur@ozonewatersystems.com
Ozone Water Systems

Oxygen-fed ozone generators, while smaller in footprint, consume more energy than to air-fed generators; and can create gas imbalance problems. The authors will present cost-versus-payback scenarios to convert an oxygen-fed system to air-fed system; and discuss gas imbalance problems that can occur. Simplified operations and upkeep are also discussed.

Analysis of Nutrients in Fresh and High Salinity Water by Ion Chromatography

Dr. Jay Gandhi
jgandhi@metrohmusa.com
Metrohm USA

A growing concern has been placed in recent years over the water quality associated with nutrient levels in several types of high salinity water that are vital to the marine life, large aquariums and fish/shrimp farms. Excessively high concentrations of nitrite, nitrate and phosphate have shown to deplete oxygen and pose adverse effects on these salt water species. However, routine monitoring of these nutrients in high salinity water matrices remains challenging. In this study, an ion chromatographic (IC) method was developed that has the ability to determine ppb levels of inorganic nitrogen and related anions and Cations, including nitrite-N, nitrate-N, phosphate-P, and ammonia in a single run using a combination of UV and conductivity detectors. The method achieved a good chromatographic separation of common seven anions (including nitrite, nitrate, and phosphate) and five Cations (including ammonium). The detection limit and recovery meets or exceeds previous methods that are applicable only to freshwater. In this presentation, a simple yet robust IC method will be discussed along with data for fresh water and high salinity water.

Low Maintenance Denitrification

Andy Aiken
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National Aquarium

Water changes continue to be the most practical and common form of nitrate reduction in seawater LS systems. Water changes however are counter-productive to reducing artificial seawater manufacturing costs and to Green initiatives and practices. Advances in denitrification systems are being made, however heterotrophic (methanol based) systems are often found to be problematic due to high levels of biogrowth/biofouling, while autotrophic systems have proven to be space inefficient due to relatively low removal rates on anything larger than

bench-scale systems. The National Aquarium employs a sulfur based autotrophic denitrification system that has attained >80% reduction in nitrate (from 300 mg/L as NO3 to below 60 mg/L NO3) in a 260,000 gallon elasmobranch/teleost exhibit. Total footprint of the system is 50ft sq. Removal rates exceed those of bench-scale systems by using a balance tank and varying pump rates to maximize system efficiency. More than 100,000 gallons of seawater have been saved in a four month period. Operation of the system does not require elaborate controls such as redox probes or modulating valves. Operation is user-friendly, and consists of manually varying two independent flow rates, filter backwashing and nitrogen gas purging. Basic system requirements are discussed.

Tuesday, April 10, Session 3.
Propagation

Sponsor Presentation – Cairns Marine Aquarium Fish

Breeding Behavior and Captive Propagation of the Ribbon seadragon, *Haliichthys taeniophorus*

Paula Branshaw Carlson
paula@dwazoo.com
The Dallas World Aquarium

Depicted as the rainbow serpent in Aboriginal art, the drawings of the Ribbon seadragon, *Haliichthys taeniophorus*, first appeared in Arnhem Land rock art more than 6,000 years ago.

More accurately described as a pipehorse, little is known about the natural history of this unusual member of the Syngnathidae family. Unlike its relatives the Leafy seadragon, *Phycodurus eques*, and Weedy seadragon, *Phyllopteryx taeniolatus*, found in the temperate waters off the coast of Southern and Western Australia, the Ribbon seadragon is a tropical species, found around Irian Jaya and the coast of northern Australia from Shark Bay in Western Australia to the Torres Strait.

In August 2005, The Dallas World Aquarium became one of the first public aquariums to acquire this unique fish. On November 10, 2006 the first captive bred Ribbon seadragons were born. Since that time, our facility has experienced unprecedented success in breeding and rearing this relatively unknown species. In November 2007, we began to exchange these captive born specimens with other public aquariums throughout the world.

Behavioral observations will prove to be invaluable for future propagation efforts and potential collaborative research programs.

We hope that through these collaborative efforts, Ribbon seadragons, like their seahorse relatives, will become important ambassadors for the conservation of their fragile marine habitat

Breeding Coldwater Fish at the Aquarium of the Pacific: Comparing Rearing Strategies for the Pacific Spiny Lumpsucker vs. the Sailfin Sculpin

Janet Monday
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Aquarium of the Pacific

The Pacific spiny lumpsucker (*Eumicrotremus orbis*) and the sailfin sculpin (*Nautichthys oculofasciatus*) both inhabit similar natural environments and are commonly exhibited coldwater fishes in public aquariums. We have successfully reared these animals at the Aquarium of the Pacific in Long Beach. In this presentation, I will talk about the care involved in keeping these species as well as the reproductive habits seen in their exhibits. I will also discuss the methods and strategies used to raise both species from egg to adult. Post-hatch, both species use different evolutionary strategies to conserve energy and survive in their environment. I will compare and contrast these differences.

Experiences in Brooding the Sun Polyp coral, *Tubastraea sp.*

Bob Snowden
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Pittsburgh Zoo & PPG Aquarium

Sun polyp, *Tubastraea sp.*, corals were acquired from a USFW confiscation in the early fall of 2010. These corals were originally collected in Indonesia. Brooding cycles in this coral are somewhat poorly understood, and it was not known what the actual planulation cycle, if any, would be considering that they were taken from another part of the world. Three of the specimens were placed into a harvester nightly for over 1 year to try and document their planulation cycles. These corals at the Pittsburgh Zoo & PPG Aquarium are exposed to natural light via sky lights and large outdoor windows in front of the propagation systems. Being exposed to natural light levels, could elicit brooding based on lunar cycles and photoperiod. It is hoped that a cycle will make itself apparent in the data, which will help to optimize propagation efforts in the future. If a cycle is apparent in the data, either from moon data or otherwise, then harvesters only have to be set up during peak cycle times. Literature reports differing cycles in-situ with the only ex-situ reports being from flow through systems set up at the site of collection. The resulting corals from this type of propagation can be used as surplus to other AZA institutions, education, and exhibitry. This type of propagation could help relieve collection stress on wild populations.

Rising Tide Conservation Egg Collection, Packing and Shipping Methods

Ramon Villaverde
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Paul Rinehart
paul.rinehart@columbuszoo.org
Columbus Zoo and Aquarium

Rising Tide Conservation was started in 2009 by SeaWorld Parks and Entertainment to address the issue of making tropical marine fish breeding an economically viable alternative to wild collection. In 2010/2011 the project was supported by the Association of Zoos and Aquariums/ Disney Worldwide Conservation Fund through a Conservation Endowment Fund grant of $22,500 focusing on the key issues of egg collection, shipment and larval rearing with appropriate live feed. Participants involved in the project include Columbus Zoo and Aquarium, Georgia Aquarium, Henry Doorly Zoo, Virginia Aquarium, Steinhart Aquarium, Shedd Aquarium, Seaworld Orlando, Florida Aquarium and the University of Florida Tropical Aquaculture Laboratories.

Participating aquariums set up egg/larvae collection devices in various systems at their facilities. Collected specimens were then packed and shipped to University of Florida TAL facility where the animals were hatched and cared for in attempts to raise them to a juvenile state.

We at the Columbus Zoo and Aquarium have had great success in our 100,000 gallon tropical mixed species exhibit. Through DNA work done by Tom Waltzek at UF, over 6 species of fish have been identified as breeding at our facility.

We will be presenting an overview of the system, egg collection devices, methods of collection, harvesting, cleaning of viable eggs and shipping methods.

What's that Fish?
Developing an Photographic Key Based on Barcodes for Species Spawning at Public Aquariums

Andrew L. Rhyne
arhyne@rwu.edu
New England Aquarium / Roger Williams University

The majority of marine organisms held by public aquariums are harvested from coral reef habitats. There is an interesting level of concern regarding the loss of biodiversity and reef ecosystem health. In order to better adhere to the mission of natal ecosystem conservation, public aquaria are developing a more ‘sustainable’ source for the acquisition of display specimens. One part of a broader plan put forward by AZA will rely on captive propagation.

Large marine tanks contain a multitude of species that are spawning naturally. If the identities of the eggs spawned are known, new technologies for rearing ornamental specimens can be developed. Documenting the species spawning at public aquaria would be the an important step in developing a sustainable source of tropical fish. Additionally the development of captive culture technologies for public aquariums could spar new industry development in importing and source countries alike. Hatcheries have been developing captive technologies to successfully propagate popular ornamental broodstock individuals (i.e clownfishes, gobies and dottybacks) but often lack the ability to spawn many species held in public aquariums.

Biodiversity identification through DNA barcoding process examines species richness within a specific gene region. These barcodes are useful for amassing reference libraries containing large amounts of species. The 16S ribosomal RNA gene has been used in species identification along with the observance of morphological characteristics that tend to be species-specific, such as egg shape, diameter, oil drop size and color, as well as yolk sac volume. In this study we used the barcoding 16S and COI genes to identify species in the egg and larval life history forms and constructed an effective protocol that can be applied to on-site identifications in public aquariums. Efficient, reliable species identification is an important step in developing rearing methods targeted at a large number of species.

Tuesday, April 10, Session 4.
Freshwater

Sponsor Presentation – Illumination Technologies

Aquatic Field Surveys in Paraguay

Lee Jackson
ljackson@rivermuseum.com
National Mississippi River Museum and Aquarium

Beginning in 2006, The National Mississippi River museum in partnership with the University of Dubuque began annual fish surveys of the Mbaracuyu reserve. The reserve is a coastal Atlantic forest remnant, and the largest protected area in Paraguay. This presentation is a description of that work as well as future plans for a country wide survey of fishes and amphibians in partnership with the university of Paraguay and several local NGOs.

Project Piaba:
20 Years of Studying the Aquarium Fish Trade; Now Time for Aquariums to Take Action

Scott Dowd
sdowd@neaq.org
New England Aquarium

For more than 20 years, Project Piaba has conducted the most comprehensive study of the aquarium fish trade, from capture to hobbyist. The focus of the work has been the cardinal tetra (*Paracheirodon axelrodi*) fishery and global market. The most substantial discovery is the critical role that a wild-capture fishery can play in livelihoods, poverty alleviation, and how effective economically driven environmental stewardship can be a unique and powerful tool to protect areas of biological importance that would otherwise be lost.

The social and environmental benefits elucidated by Project Piaba's study of the cardinal tetra fishery are not unique to the region from which these fish come. Many species found in the aquarium fish trade share the natural history characteristics that make the cardinal a sound species on which to base an extractive fishery. Many of these species are found in biological hotspots that are in dire need of protection.

There is a clear role that public aquariums can play to enhance social benefits and conservation outcomes by partnering with the industry to promote responsibility. The most basic function of public aquariums is to display aquatic life in the most compelling way to the largest possible audience and to convey priority and mission-pertinent

information. The hundreds of millions of people that choose to visit public aquariums are a self-selected population that by definition is drawn to fishes. There is clearly much overlap in the value of this demographic that is shared by public aquariums and the aquarium fish trade. Many of the fish species that are, and have the potential, to serve as these instruments of conservation are widely displayed in public aquariums. By spotlighting these species and conveying the social and environmental benefits of the responsible trade to our fish-loving visitorship, we can foster a market with substantial conservation outcomes.

Ny Trondro Malagasy - The Fishes of Madagascar

Paul V. Loiselle
ploiselle@wcs.org
New York Aquarium

The endemic freshwater fishes of Madagascar are the island's most endangered vertebrates. This presentation offers an overview of the Malagasy ichthyofauna, explains its extreme scientific interest, outlines the principal threats to its survival, summarizes in situ conservation efforts and explains the critical role of ex situ captive breeding programs in assuring the survival of these critically endangered fishes.

Mad Fishes

Tim McCaskie
tmccaskie@torontozoo.ca
Toronto Zoo
Alex Saunders
Denver Zoological Gardens

The fishes of Madagascar have been the focus of conservation biologists for many years, including Dr. Paul Loiselle, Curator of Freshwater Fishes of New York Aquarium (WCS), as it is well documented that the unique fauna of this island is highly imperiled. In recent years the fishes of Madagascar have become a focus program for the Freshwater Fishes TAG of the AZA. This presentation discusses the recent *in situ* efforts by Tim McCaskie (Toronto Zoo) and Alex Saunders (Denver Zoo) as they travelled to the Lake Tseny watershed in northwestern Madagascar in 2010 and 2011. Their confirmation of *Paretroplus menarambo* as present in the watershed is notable as it was considered extirpated prior to 2008. As well, they found a new fish species and extended the range of another. This was just the beginning of their adventure! The Madagascar Program is looking for more participants and the presentation will include an overview of care for these fascinating fish.

Imperiled Desert Fishes of the American West and Northern Mexico

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Dallas Zoo and Children's Aquarium at Fair Park

A general overview of the biology and conservation status of imperiled desert fish species of North America is presented. The root causes leading to the decline, extirpation, and extinction of many of these species are discussed alongside discussion of conservation efforts by government agencies, academia, zoological parks, and aquaria. A discussion of the efforts of the Desert Fishes Program of the FFTAG to date is presented, as well as the future direction of the program moving forward following recognition via approval of the RCP. These species have the smallest natural geographic ranges of any vertebrate, tolerate the most extreme changes in salinity, live across thermal extremes, and have generally adapted to the most extreme environments on earth. Considering these stunning adaptations it seems unlikely that such species would find themselves in need of anthropogenic intervention to ensure their continued survival, though stewardship across national, political, and societal boundaries may be the last remaining hope for these taxa.

Wednesday, April 11, Session 5.
Aquarium and Population Management

Cutting Shrimp AND Cost

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Ripleys Aquarium, Myrtle Beach

While we are always looking for ways to improve, in August 2010, the husbandry staff of Ripley's Aquarium, Myrtle Beach did an internal analysis of our fish food inventory to see if there were any ways to become more cost efficient. We had been noticing rising expenditures despite keeping a steady animal collection and knew that some changes should be made. Upon analysis, we discovered a few key areas that needed to be reviewed.
In meeting our goal of cost reduction two standards were kept at the forefront of our decisions. First and foremost were the dietary requirements of the animals in our collection. It may be easy to look at an inventory and pick out the most expensive food items, but we must keep in mind that even though it may be a delicacy for a local restaurant that item also may be vital nutritionally to an aquatic animal. Also, something to keep in mind is the value of certain food items as an enrichment tool (i.e. live foods vs. frozen foods). Our second concern was the effect the changes would have on our husbandry staff. Ordering whole fish vs. filleted fish, or shell-on shrimp vs. PUD shrimp could mean extensive prep time in the kitchen leading us to determine whether the amount of man hours would be worth the initial savings, or should we go ahead and get those custom kitchen aprons we've all had our eyes on?

Monitoring Energy and Water Consumption

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Siocean

Oceanário de Lisboa, as any large aquarium, has high water and energy consumptions (7,4 million gallon of water, 7 GWh electrical, 8 GWh thermal). These represent a huge share of the aquarium fixed costs. A new system to control these consumptions was developed and installed. A few dozen flow and energy meters were installed and integrated on the Building Management System, supplying information on the performance of the most important consumers (large HVAC units, restaurants, LSS, etc.). The goal of this presentation is to introduce the technology used, investment costs associated and the impact on the operational costs, plant operation and management decisions.

Intro to the AZA Population Management Center

Cara Groome Bryan
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AZA Population Management Center

Although the Population Management Center (PMC) has advised AZA programs for over ten years, there are many misconceptions about the PMC and the planning process. We hope to demystify the process of working with the PMC and clarify the roles program leaders and population biologists play in successful population management. We will discuss all stages of the planning process --meeting with the PMC, developing the breeding and transfer plan, and managing the population throughout the year. We will discuss the skills and characteristics that make a good Studbook Keeper or SSP Coordinator and illustrate the elements of a successful breeding and transfer plan. This session is intended for newer or prospective program leaders but will also be useful for existing program leaders to share stories of their problems and solutions.

Population Management of Group-living Species

Cara Groome Bryan
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AZA Population Management Center

Just because parentage is tough to track in your group-living population, doesn't mean it can't be genetically managed! Genetic theory suggests several alternatives to the widely used mean kinship strategy of genetic management. The Population Management Center has worked with many AZA programs to apply genetic management theory to taxa with varying degrees of pedigree information. We will present case studies of different management strategies developed for several group-living birds, mammals, and amphibians held in zoos & aquaria. Genetic and demographic concepts and logistical factors behind these strategies will be presented to help program leaders become more active participants in managing their own populations.

Wednesday, April 11, Session 6.
Crustacean Health

Sponsor Presentation – Dynasty Marine

Host Susceptibility as a Primary Driver of Shell Disease

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Anyone who has tried to exhibit crustaceans has noticed at some point, black spots and possibly even lesions will appear on the shell, a condition known as shell disease. At best, it looks bad from an exhibit standpoint. At worst, it can cause mortality. Any disease is caused by a triad of factors - a viable *pathogen* exists in the right *environment* in the presence of a susceptible *host*. Many aquatic pathogens such as those causing shell disease, are bacterial, and are always present to some extent in exhibits. The exhibits, ideally (from the aquarist's point of view) remain constant. Therefore, with two factors remaining constant, disease events such as shell disease cycle as a result of changes in the susceptibility of the host. To understand shell disease better, our laboratory has intentionally stressed American lobsters to increase their susceptibility. Through this method, we can intentionally cause shell disease, and allows us to look at patterns of infection. Once the lobster has shell disease, we can then figure out how to get them to be less susceptible. Poor nutrition is one of the easiest ways to make lobsters susceptible, and this talk I will link the science of shell disease to some best practices for exhibiting crustacean to keep them healthy and looking good.

Three Decades of Horseshoe Crab Rearing: A Review of Conditions for Captive Growth and Survival

Ruth H. Carmichael
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Dauphin Island Sea Lab

Threats to wild horseshoe crab populations and growing interest in their use for research, education and biomedical applications, has prompted demand for improved techniques to rear and maintain crabs in captivity. While numerous laboratory studies have been conducted to determine growth and survival of horseshoe crabs under various conditions, these data have not been compiled and summarized to inform culture practices. We surveyed the literature and analyzed the range of available techniques to identify and define a consistent set of conditions for maximum growth and survival of horseshoe crabs in culture. We considered three age classes; embryo, juvenile and adult and included all extant species (*Limulus polyphemus, Carcinoscorpius rotundicauda, Tachpleus gigas, Tachypleus tridentatus*). We discovered relatively few published studies that clearly related husbandry conditions to growth and survival. Comparison among studies was complicated by inconsistent data collection and reporting techniques. Most published sources reported data for younger age classes, and more studies considered *L. polyphemus* than Asian species. The most commonly reported variables (temperature, salinity, enclosure

maintenance, and diet composition) showed size dependent and in some cases species-specific effects on growth and survival that will be important to guide culture efforts. We suggest future studies give additional consideration to substrate type, water flow, dissolved oxygen concentrations, diet quality, and the quantity and frequency of feeding. If laboratory-reared stocks are to be used for propagation and restoration activities, future studies will benefit from closing these data gaps and promoting international data sharing.

Collaborative Marine Ornamental Fish Propagation Efforts

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The Florida Aquarium

The Rising Tide Conservation initiative began as an idea to breed marine ornamental fishes for both public aquaria and the aquarium hobby. The many challenges associated with successfully breeding and rearing many marine ornamental fish has kept most single institutions and research facilities from realizing these goals.

A collaborative effort was developed between eight AZA facilities and the University of Florida's Tropical Aquaculture Laboratory (TAL) to collect viable eggs from sexually mature fishes currently in large public aquarium exhibits. Eggs were collected using specially designed floating baskets and then shipped overnight to TAL. Scientists Dr. Eric Cassiano and Matt Wittenrich acclimated and hatched the eggs and developed the methodologies for first feeding and raising of the fry.

The successes derived from this collaboration have been many, yet have led to more questions which are now being researched. It is the intention that this program be continued and that more AZA facilities will join the collaborative efforts to reduce the capture of wild fishes for aquariums.

Wednesday, April 11, Session 7.
Elasmobranchs

Sponsor Presentation – New Era

The Effects of Temperature on *Urobatis jamaicensis* (Urotrygonidae) Reproduction

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John G. Shedd Aquarium
Dr. Aaron Schirmer, Dr Charles R. Knapp

As part of a temperature-dependent reproductive study on *Urobatis jamaicensis*, eight females and four males were maintained in two 3m diameter, 26,500 L reserve marine systems at the John G. Shedd Aquarium, Chicago, Illinois. The animals were mated once in 22˚C water and then again in 27˚C water over a two year period. All other environmental parameters remained constant throughout the study. Mating dates were documented via bite wounds and crosschecked against surveillance video recorded by overhead cameras. For the first breeding cycle in 22˚C water, three of the eight females were confirmed pregnant on their second month ultrasounds. On their fifth month ultrasounds, their uterine horns contained what appeared to be embryonic tissues but no fetal heart rates could be detected. On their sixth month ultrasounds, their uterine horns were filled only with fluid and all three were developing new follicles within their ovaries. In the time between these ultrasounds there was no evidence of stillborn discharge or maternal cannibalism. The second breeding cycle, in 27˚C water, also yielded three pregnant females. Two of these females carried their pups to full-term and gave birth after an average six-month gestation period. The third pregnant female in this group went into pre-mature labor at five months, giving birth to a stillborn pup. The growth rates of the pups and the mothers were followed during this study by collecting regular disc width and body mass measurements. Since *U. jamaicensis* are known to be seasonal breeders, they may require seasonal cues for proper embryonic development. The absence of optimal environmental conditions may ultimately have resulted in the reabsorption event witnessed during the first part of this study. The data presented here should be corroborated with further study, and considered when determining the requirements for optimal breeding conditions of elasmobranchs.

A Year in the Life of Spotted Eagle Ray Pups *(Aetobatus narinari)*

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Disney's The Seas with Nemo and Friends

Spotted eagle rays (*Aetobatus narinari*) have been breeding successfully in aquariums for years. Disney's The Seas with Nemo and Friends® were fortunate enough to have success in January 2011 when our female spotted eagle ray gave birth to three male pups. Throughout the first year of their lives, we tracked the pups' food consumption and diet preference, analyzed their growth rates and body conditions, and documented medical challenges and interventions. Currently, we are establishing training plans and techniques. This presentation will highlight our journey raising spotted eagle ray pups and what we have learned thus far.

White-Spotted Bamboo Sharks *(Chiloscyllium plagiosum)*: Clasper Removal and Hematology Findings

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Downtown Aquarium – Denver

Aggression among male White Spotted Bamboo sharks (*Chiloscyllium plagiosum*) has caused health problems at several public aquariums, including the Downtown Aquarium Denver. Several sharks at the Denver Aquarium have developed extensive clasper injuries as a result of this aggression between tank mates. These sharks, although apparently appetent, have decreased body conditions. In an effort to improve the general health of those sharks with no sign of recovery, the claspers were surgically removed. Preliminary findings showed that sharks with any evidence of clasper injury had a median white blood cell count (WBCC) of 37,730/uL. It was suspected that removing the claspers would reduce the WBCC as well as show clinical improvement with the sharks.

This presentation will describe methods of surgically removing the affected claspers, the post-operative care, and post-operative complications. A brief description of performing the WBCC technique using the Natt-Herricks dilution and hemacytometer will also be presented as this has been an affordable yet invaluable diagnostic tool. The pre- and post-operative hematological data (WBCC and packed cell volumes) will be compared among males as well as to the data collected from the female sharks. Information concerning the improvement or deterioration of the sharks post-operatively will be shared and discussed. Hopefully, this information can help other aquariums with these types of health issues.

Husbandry and Breeding of the Blue Spotted Stingray *(Taeniura lymma)* at Oceanário de Lisboa

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Oceanário de Lisboa

The Blue Spotted Stingray or Ribbontailed Stingray (*Taeniura lymma*) is a very attractive species to keep in aquariums. However, due to the few breeding events in captivity, it is necessary to capture specimens in the wild in order to keep this species in exhibit in Public Aquariums. Husbandry programs have been carried out in some public aquaria in order to uphold captive breeding of this species and to alert people about its conservation. Oceanário de Lisboa currently has 10 individuals (five of them born at the aquarium facilities) and has created a monitoring and training program in order to study and promote reproduction of T. lymma. The work that has been developed with this species in the aquarium focused pregnant females monitoring procedures, birth in quarantine, growth and training to further introduction on the exhibit. Individual monitoring and training turn out to be essential to better understand its behavior minimize stress while handling and successfully breed this fascinating species.

Collection, Husbandry and Medical Management of a Blue shark, *Prionace glauca*, in Portugal

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Flying Sharks

On June 2011, a small Blue shark, approximately 70 cm long, was captured at the Tunipex set-net in the South of Portugal. The specimen was transported to Flying Sharks' temporary holding station in Olhão and was kept there for approximately one month before being transferred to the Oceanário de Lisboa.

The Blue shark was introduced to a quarantine tank at the Oceanário de Lisboa on June 22nd. Transport methodology, husbandry and medical approach are reported in great detail. We also describe a variety of problems encountered and their resolution, such as physical manipulation and feeding strategies, anorectic episodes, forced feeding protocols, traumatic and infectious cutaneous lesions, dehydration and a traumatic unilateral corneal ulcer.

Wednesday, April 11, Session 8.
Collection, Transport, and Acclimation

Sponsor Presentation – Piscine Energetics

They're Here! Now What? The Art and Science of Receiving a Long-Haul Animal Shipment.

Laura R Simmons
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Cairns Marine

Receiving a shipment of live animals from the other side of the planet after a long haul flight can be a daunting process. As freight costs continue to escalate, fully utilizing aircraft pallets or attaining `freight breaks', is a necessity for cost effective transports. This can result in visually overwhelming numbers of containers and boxes on arrival all requiring attention. This is a stressful process for both animals and aquarists alike with stress directly proportionate to the size and complexity of the shipment.

There is no way to completely alleviate the pressure that surrounds such a project, but there are many steps that can be taken to ensure a successful result.

This presentation will focus on explaining what aquarists can expect when receiving a diverse pallet of containers filled with various sizes and species of animals. It will describe the process to prepare the animals for their journey. It will shed light on many of the physical and physiological stresses the animals go through during their extensive travel. Most importantly it will explain how to reduce stress through great preparation and a solidly performed acclimation.

Acclimation and introduction into the animals' new habitats are key to their straight-forward quarantine and long term success. Understanding the background impacts on the animals that led up to the animals' arrival is imperative to being able to manage them up to 48 hours after they were loaded onto a plane.
There can be a bit of creativity involved, but the science and tools required are often overlooked or not fully understood.

For all concerned, a successful result is not only a large, long-haul animal shipment that arrives in good condition, but also ensuring that the animals are given the opportunity to thrive in their new homes through proper handling every step of the way.

The Mother of All Long-Term Transports: Be Afraid, Be VERY Afraid

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Flying Sharks

In March 2010 Flying Sharks received its largest order ever, consisting of 3.100 fish (and invertebrates) that were shipped to the new Istanbul Aquarium in December 2010. Mortality rate was less than 0,1% (i.e. 3 individuals) and the list of animals covered a long and diverse list of species, ranging from fast pelagics (e.g. *Sarda sarda*, *Trachurus trachurus*) to the smallest rocky-shore ornamentals (e.g. *Parablennius gattorugine*). Collections were therefore staged in four different locations: Olhão (South of Portugal), Peniche (West of Portugal), Funchal (Madeira Islands) and Horta (Azores Islands).

Collections, however, were but a very small fraction of this mammoth 44 tanks operation, as holding needed to occur during the hottest months of the year and that pushed for multiple and innovative solutions to over-stocking. Furthermore, the weeks preceding the two fully loaded A300 aircrafts transport were filled with original barriers that the team had to overcome, often within minutes. Such unexpected barriers included, for example, the sudden addition of two tanks of (very) coldwater animals that required holding in a facility with no chilling capacity and fighting for space with cows (you read it right) on a ship.

This paper reports on the myriad of "original" solutions adopted and also on the infinite details that need to be addressed when preparing for a large charter flight loaded with live marine animals. It also reports on the final preparations and the transports per se, including a maritime 5 days stretch done on a commercial container vessel, which required extremely colorful troubleshooting.

Closed-System Oxygen Consumption and Supplementation of Pacific Sea Nettles *(Chrysaora pacifica)*

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Georgia Aquarium
Wyatt Patry, Dr. Alistair Dove

Maintaining dissolved oxygen (DO) levels while transporting jellies can be challenging because gaseous air in the shipping bags can be detrimental to their health. In April 2011, the Monterey Bay Aquarium requested that balloons containing O_2 be packed with half of a shipment of Cannonball jellies (*Stomolophus meleagris*) being sent from the Georgia Aquarium. The idea originated from a guest visiting MBA. Preliminary results were encouraging, and spurred a pilot mock-transport experiment where 76 Pacific sea nettles (*Chrysaora pacifica*) were packed in plastic bags with RO seawater at 98.6% DO, some with a 12-inch latex balloon half-filled with O_2, and some without balloons. After approximately 24 hrs, all bags with no balloons had decreased DO, and 87% of bags with balloons had increased DO. In October 2011, a larger-scale, controlled mock-transport experiment was conducted to examine 2 factors and their interactions: effects of O_2 balloons on DO levels, and O_2 consumption by *Chrysaora pacifica*. Eighty-eight bags received 1 of 4 treatments/controls: A) no jelly, no balloon; B) no jelly, with balloon; C) with jelly, no balloon; D) with jelly, with balloon. After an average 23 hrs, O_2 consumption by a single jelly in 17 liters RO seawater averaged 1.83 mg/L at a mean temperature of 16.7°C. Jellies also had a small but significant negative impact on pH. Analysis by 2-way ANOVA demonstrated that jellies and balloons each had highly significant effects on DO, with balloons having a much larger effect than jellies. Interactions between jellies and balloons were also significant. These results not only supported the hypothesis that O_2 balloons are an effective means of supplementing DO, but they also showed that O_2 balloons compensate for the O_2 consumed by jellies. Results from similar mock-transport experiments of jellies with and without balloons conducted at MBA will also be presented.

Who Uses Cyanide Anymore?

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Cairns Marine

For many years we have viewed cyanide fisheries as the epitome of destructive fishing practices and the scourge of the international aquarium supply industry. It has certainly been a focus of concerted and dedicated effort from international NGOs to turn it around. But do any of us understand that the use of stupefactants has traditionally featured in the cultures of some countries that supply the international aquarium trade? And do we understand that the transition to the use of a sodium cyanide solution predates an international aquarium trade? In this presentation, Lyle Squire will outline the historical drivers of the transition to sodium cyanide as a means to stupefy fish for food, on a grander scale than had previously been practiced, after the Second World War. He will explain how the use of the compound was a natural fit for the commercial supply of ornamental fish from the 1950s and much later for the commercial supply of food fish for the live reef food fish trade into China. The substantial and valiant efforts of international NGOs to transition cyanide aquarium supply fisheries to low impact collection methods, together with efforts to affect consumer choice, have not been matched by ongoing financial support for their important work. The absence of news emanating from this work in recent years has led some to ask: Who uses cyanide anymore? Drawing on the collaborative international efforts to conserve biodiversity in the Coral Triangle, this presentation investigates the current status of cyanide use to supply the international aquarium trade. Is it still an issue?

Quarantine Strategies Adapted to Fishes Caught Directly Out of Stressed Conditions in the Wild

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During the course of the last 30 years, the environment and water quality off the Florida Keys and south Florida has continued to diminish as the coral reef has declined to the very stressed and greatly reduced state as it currently exists. Where great and extensive stands of *Acropora* and many other coral species used to thrive in the 60's and 70's and the previous 4000-5000 years that south Florida enjoyed a sub-tropical climate, now exists either a barren hard-pan gorgonian bottom or algae covered rocks with a few live coral heads left among them. Florida Keys communities to this very day not fully treating human sewage effluent that continues to flow into the environment and nutrient loading is a widespread result.

The Florida bay has suffered a similar or worse decline as freshwater flow through the Everglades has been either drained or diverted for housing and development needs and the remaining water flow is nutrient loaded with agricultural run-off and other human source point nutrient loading. High salinities well over 40 ppt are a common event during the warmer summer months.

In January of 2009, an unusual cold weather event caused 10 days of shallow near shore sea temperatures below 9-10 C. This cold event of epic proportions killed over half of the large 2-3m diameter brain corals and other remaining coral colonies to as far out as 2-3 miles off shore. With the loss of diversity of habitat and stresses to the system, the degree of parasitism that has to be contended with has increased by nearly an order of magnitude. Various systems and procedures, specifically for freshly captive fishes and use of treated natural sea water have been developed to deal with these parasite pathogens and water quality issues and will be described in detail.

Thursday, April 12, Session 9.
Conservation

Conservation in the Classroom

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CUNY - Graduate Center and Brooklyn College

Conservation biology is a fast growing field in the scientific community and maintaining direct and clear communication with the public is vital. The National Science Foundation supports a GK-12 Fellowship at universities throughout the United States. The particular GK-12 program at Brooklyn College is called, City-As-Lab, and pairs graduate students with Brooklyn high schools to illustrate the importance of science in the local community. As a fellow in the program, I have worked at the Brooklyn Academy of Science and the Environment to coordinate and plan science projects that have related important topics, such as water quality and conservation, to the urban environment that the students live in everyday. This program has also given me the opportunity to share my current conservation based research on the chambered nautilus with the high school students in the classroom and discuss important concepts with the students. The students have been extremely receptive and have enjoyed field trips involving seine nets and laborious water quality testing while also being creative and attentive during classroom lessons. The success of modern scientists is becoming increasingly dependent on the scientist's ability to communicate to a broad audience. It is no longer acceptable to only converse with other scientists behind closed doors. The National Science Foundation is committed to improving scientific communication with a broader group of citizens and the program that I am currently in certainly accomplishes that goal. Through the program, I have improved my communication skills with high school students through field trips, creating lesson plans, and assisting students with their individual projects and interests. As Kurt Vonnegut wrote, "Any scientist who cannot explain his work to an eight-year old is a charlatan".

Bobbing Brushes: Collecting Larvae Out in the Pacific

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Ocean Institute

The Ocean Institute lives by the following creed: Experience is the Teacher. Our latest endeavor has developed many partnerships and implemented a unique hands-on experience. The Nicholas Endowment has provided the Ocean Institute with the opportunity to create our Larval Settlement Laboratory. Interns and staff use our petite lab to focus on the youngest life stages of marine organisms including settlement and recruitment dynamics.

Currently, we are analyzing larval settlement at the largest artificial reef in the United States. The reef, coined Wheeler North Reef, was completed in 2008. It was built just off San Clemente to mitigate any impact on marine life from the San Onofre Nuclear Generating Station (SONGS). SONGS requires the ocean's water to cool its system so when the water exits back into the ocean, it is warmer and raises the temperature of the ocean around the plant. This increase in temperature affects the normal and natural growth of kelp; thus, the need for an artificial reef.

This reef is already home to many species and hopefully, hundreds more as it develops. Our team is conducting research in collaboration with senior scientists at UC Santa Barbara by deploying brushes within the reef to see what organisms settle.

Restoring Coral Reefs through AZA Partnerships

Ken Nedimyer (*Presented by Kevin Gaines*)
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Coral Restoration Foundation

The Coral Restoration Foundation (CRF) has actively restored reefs in the Upper Florida Keys for over ten years. CRF has pioneered culture methods for two Endangered Species Act "threatened" hard corals, staghorn and elkhorn. The mission of CRF is to develop affordable, effective strategies for protecting and restoring coral reefs and to train and empower others to implement those strategies in their coastal communities.

CRF has planted over 1,000 staghorn corals at Molasses Reef in Key Largo in 2011. Using volunteers from local high schools, dive clubs and beyond, CRF has achieved a 95% survivorship rate on the corals outplanted from the nursery to the reef after one year of monitoring. There are many opportunities for AZA institutions to become involved and partner with CRF. From the 85 plus types of staghorn genotypes at our nursery to long-term monitoring on outplanted sites, research by CRF is limited and science expertise is welcomed.

CRF has been fortunate enough to partner with the Florida Aquarium to compare land-based staghorn coral growth and survivorship with CRF's nursery-raised corals. This ongoing collaboration has also developed pioneering work in coral spawning and fertilization studies which will one day lead to increased awareness regarding natural recruitment and possible land-based sexual coral reproduction.

The Georgia Aquarium has also partnered with CRF. GA staff have worked in the staghorn and elkhorn nursery, outplanted corals to their Molasses Reef sponsored site and helped with maintenance and monitoring at several other reef restoration areas.

CRF is excited to work with other AZA institutions to further their conservation mission and help support our valuable and successful restoration programs in the US and abroad.

Florida Coral Rescue from the Navy's Truman Mole Pier Key West, FL, November 2011

Bob Snowden
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Pittsburgh Zoo & PPG Aquarium
Mark Schick, Ryan Czaja, and Kim Hall

Four AZA institutions took part in a coral rescue from the Navy's Truman Mole Pier in Key West, Florida in mid to late November 2011. The Pittsburgh Zoo & PPG Aquarium, the John G. Shedd Aquarium, the Georgia Aquarium, and the Florida Aquarium all took part in this rescue effort. Overall, 465 corals were rescued from the pier wall and nursery area. These corals are being held at all 4 facilities and will be used for display, education, and propagation efforts.

Reed Mariculture

Chad Clayton

Thursday, April 12, Session 10.
Exhibits and Animal Health

Sponsor Presentation – Living Color

Our Glowing Seas, The Mystery of Underwater Fluorescence

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An underwater mystery is being brought to the surface. Bioluminescence is a well-known underwater phenomenon, and how it is used by the animals that produce it has been well studied. Fluorescence has also been well studied, but its biological function in marine organisms is far less understood. Early theories of why animals fluoresce are that fluorescence is a form of sunscreen or, of course, that it is used for communication. The Oklahoma Aquarium recently hosted a photography exhibit by Brandi Irwin: "Something Special Underwater". Ms. Irwin and her team at Liquid Film Photography specialize in photographing and filming fluorescence. While the team was at the Aquarium, we decided to see what was fluorescing in our own "backyard". What we discovered did not disappoint, we discovered many species fluoresce under the proper lights and while viewed with the proper lenses. The number of animals that fluoresce in aquariums opens the door for further research of the biological function of fluorescence. It also provides a wonderful educational opportunity for us to offer after hours night tours for guests where they can experience yet another wonder of our planet; the scope of our glowing seas.

Animal Attraction: What's Love Got to Do with It?

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Steinhart Aquarium, California Academy of Sciences

Nothing in life is more important than sex. Most of what we consider beautiful and flamboyant in the natural world is concerned with reproduction. From a bird's plumage, to the color and shape of fruits and flowers, organisms are designed to enhance their potential to reproduce. Sex drives evolution; the recombination of genes leads to the creation of completely new genotypes that either survive or perish. This winter the Steinhart Aquarium at the California Academy of Sciences unveiled the first new aquarium exhibition since our re-opening in the fall of 2008. Titled *Animal Attraction*, 18 exhibits highlight the means and methods used by a variety of plants and animals to reproduce. From deep sea anglerfish to banana slugs, this exhibit uses both preserved and live specimens to illustrate a bewildering array of reproductive methodologies. In addition, Apple's iPad2 is being used as an interactive digital label for the first time in a public aquarium. The iPad provides content for each exhibit, including video, still images and text, and allows visitors to explore at their own pace and learning level. This presentation will discuss the development of the exhibit and illustrate the organisms within.

Quarantine Exhibit: How to Medicate Fish (But Not Inverts) When They Have Nowhere Else to Go

Wendy Lee
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Waikiki Aquarium

The Waikiki Aquarium has had many groundbreaking successes in the field of husbandry throughout its history. It is no doubt that these successes are results of great husbandry, amazing animals, and obviously, the "magic water." This "magic water" is just one component that has made the Barrier Reef exhibit renowned amongst colleagues, hobbyists and visitors.

The newest exhibit at the Waikiki Aquarium features the Papahanaumokuakea Marine National Monument. Representing the largest fully protected marine conservation area on the planet, the expectations for this exhibit were set high. Not to outdo the Barrier Reef exhibit at 5,500 gallons, this exhibit was set to have a total capacity of 4,000

gallons. Intended to be an open system, the new exhibit would have state of the art life support equipment to support the high bio-load of rare fishes and corals collected over the course of two years by special permit.

Just weeks to opening, Murphy's Law set in. Due to chiller failures (14°F increases in temperature) and UV sterilizer malfunction, vast numbers of fish were lost. Initially, we knew that we were up against ciliates. There were clear limitations as to where our treatment options within this reef tank laid. With limited holding space, removing all the fish to treat outside the tank was never an option.

The famous Rich Terrell chloroquine gel diet would be our first option. Along with modifications to the life support system and water source since the initial catastrophes, modifications to the chloroquine gel diet have been made. Additionally, other oral medications have been established as a monthly regimen.

Despite the occasional flare up in disease activity, fish populations have remained fairly stable. Disease has not progressed past the help of chloroquine. This exhibit, like many, will never be disease-free, but for now, the bugs have been suppressed.

Aulani: Review of our Marine Teleost Quarantine Process

Eric Curtis
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Aulani, a Disney Resort and Spa
Marjorie Awai, Jeffrey Sedon, Kirk Murakami, Amy Reierson, and Jane Davis

On August 29th, 2011, Aulani®, a Disney Resort and Spa opened on the island of Oahu in Hawaii. It has exhibits that showcase freshwater koi, a local stingray species (*Dasyatis lata*), and 41 species of marine reef fish. I will present the marine teleost quarantine procedures that were used and detail the challenges that had to be overcome. Procedures that were used included: moving fish to clean tanks every three days with concurrent Praziquantel treatments; freshwater dips on arrival; copper; Chloroquine; and Praziquantel. The last protocol was the performance of exit exam diagnostics including skin scrape, gill clip and cloacal lavage on 10% of the individuals of each species. In our first runs the average survival rate was 87% but after our biofilters were completely cycled the average quarantine survival rate was just over 95%, although we did experience higher mortality in certain species.
A total of 15 groups of fish was quarantined within a period of 174 days. We had 6 different quarantine systems at 2 different locations. Copper was only used for one group while the remaining 14 groups all had Chloroquine as the primary antiparasitic agent. As in all newly constructed systems with short time-lines, the biological filters associated with these quarantine systems had fluctuating water qualities during the first quarantine runs. In order to maintain appropriate water quality, we used Amquel® (Kordon LLC, Hayward, CA) additions, large water changes, and the addition of live bacteria cultures (FritzZyme™ Turbostart™ 900, Fritz Ind. Mesquite, TX) to assist our struggling biofilters. Water quality stabilized once the biofilters had been exposed to the various treatment regimes and the biofilters cycled. I will present some interesting observations that were made of these quarantine groups and speak to current thinking in regards to their etiology.

SECORE Information

Bob Snowden

Vitamin D-3 in Captive Green Sea Turtles *(Chelonia mydas)*

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Shark Reef Aquarium

During an accreditation review of the Shark Reef Aquarium at the Mandalay Bay Hotel in Las Vegas, Nevada, AZA (Association of Zoos and Aquariums) reviewers expressed concern about the possible effects of low light intensity and absence of ultraviolet light on serum 25-hydroxyvitamin D levels in our green turtles (Chelonia mydas). In an effort to address this concern, blood samples from the aquarium's 3 resident green turtles were periodically analyzed over a 5-year period. Serum 25-hydroxyvitamin D level in a green turtle living at a second

indoor facility for 432 months was also analyzed. Two of 4 turtles housed at a third facility were moved from an outdoor to an indoor habitat, and serum 25-hydroxyvitamin D level of all 4 turtles was measured over a 2-year period. In this limited population, serum 25-hydroxyvitamin D levels began to decline about 4–5 months following indoor confinement and continued to decline for 6–8 years. Turtles in the outdoor facility had vitamin D3 blood serum concentrations of 60–70 nmol/L.

After 6–8 years of confinement indoors, blood serum concentrations of vitamin D3 declined to 5– 15 nmol/L. Although clinical symptoms of low serum 25-hydroxyvitamin D levels were not detected during regular veterinary examination of this limited study population, further research is needed to elucidate the long-term effects of restricted ultraviolet exposure or low dietary intake of vitamin D3 in green turtles. Blood serum concentration of vitamin D3 in wild turtles has apparently not been reported.

Kicking it "Old-school"- The Use of Honey
in Abscess Treatment for Kemp's Ridley Sea Turtle, Lepidochelys kempii

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Common, everyday, store bought honey, was used for post-surgical treatment of an abscess located at the base of the tail on the ventral side of the carapace on a 17 year old, Kemp's Ridley sea turtle, *Lepidochelys kempii*. Honey has been said to have been used by the Egyptians for wound and burn treatments over 4000 years ago. Most of these “old-school” remedies have been forgotten or substituted with modern medicine replacements. These natural remedies have proven to be beneficial to wound treatment to kill bacteria and enhance granulation using acidic pH and osmolarity. There is limited knowledge and documentation of the use of honey to treat wounds and burns in reptiles. Previous documentation has been limited to small animal veterinarians in the treatment of dogs, cats and other mammals. We first discovered honey being used to treat wounds by the Sea Turtle Hospital on Marathon Key. With the location of the abscess in the upper layers of the epithelium we felt that treating the wound with honey would be the most successful course of treatment. A marsupialization technique was performed to keep the abscess open to allow for daily flushing with dilute Betadine and honey administration. After treatment the sea turtle was “dry docked” for 20 minutes then replaced back in her holding pool. The healing process took approximately 11 weeks with no complications. The abscess completely healed and the sea turtle made a full recovery. Due to our success with the honey treatment we have continued to use it as a standard treatment for other wounds and lacerations on our other sea turtles and terrapins.

Hyperbaric Chambers for Rockfish at the Monterey Bay Aquarium

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Monterey Bay Aquarium

The diverse and numerous rockfish (Sebastes spp.) living between 30 and 200M deep in Monterey Bay have been under-represented in the Monterey Bay Aquarium's exhibits because of the difficulty in collecting and holding healthy animals from these depths. In the past, aquarium collectors have positioned themselves using SCUBA gear at 20 meters under a fishing boat to receive rockfishes being reeled up. Here the fishes' airbladders were relieved with hypodermic needles before passing the fish up to the surface. This was a successful collecting method though it was logistically challenging. More recently, Jeff Smiley (Hubbs-Sea World) brought large rockfish straight to the surface from over 100 meters. These fish were quickly moved into pressure vessels and successfully recompressed and decompressed for eventual acclimatization to surface pressure. Inspired by Smiley's efforts, and also by some smaller chambers developed by Jeff Landesman (Cabrillo Marine Museum), we have developed and employed two types of pressure vessels: One is stainless steel and is pressurized with oxygen gas; the other is built of PVC pipe components, has a “two stage” function, and is pressurized with a water pump. These vessels work well for small to medium-sized rockfish, are transportable, easy to build and operate, and inexpensive. We have collected rockfish with hook and line, trawls, or traps from up to 150 meters depth. Rockfish that have been successfully acclimated to the surface in these vessels include bocaccio, canary, chillipepper, cow cod, greenstriped, greenspotted, halfbanded, rosy, squarespot, starry, and widow. We are helping supply live fish for

research, including post-barotrauma rockfish vision investigations done by Bonnie Rogers (CSU Long Beach). We are also using recompression for routine hook and line or scuba collection of nearshore species.

So Your Dragon Won't Eat...

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Any facility that keeps Leafy or Weedy seadragons will have the occasional health problem in their dragon population. This often results in animals that are too debilitated to feed. In the early days of keeping seadragons, we rarely force-fed them because they just seemed too delicate. But dragons have a straight gut and feed constantly throughout the day. When they are compromised or in distress and not eating, it's necessary to get calories and often oral medication into them. At SeaWorld, assisted feeding is a necessary part of our treatment regimen and results in marked improvement in their long term prognosis. Depending on the case, we have three distinctly different methods for force feeding situations: Assisted Feeding, Force Feeding and Tube Feeding. Specific cases, method descriptions and the pros and cons of choosing each method are demonstrated through video, slides and dialogue.

Friday, April 13, Session 11.
Quarantine Workshop

Roger Klocek
Guest Keynote Speaker

Developing Quarantine Protocols for your Facility

William Hana
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John G Shedd Aquarium

Successful introduction of new animals to an existing collection requires an effective quarantine. The period of time of enforced isolation and restriction of movement can greatly decrease the possibility of disease transmission to healthy animals already on exhibit. Preventative treatments, administered appropriately, can further reduce or completely rid animals of targeted parasites. As applied to animals, quarantine also serves as a period of acclimation to new environments to ensure success of long-term captive survival.

Existing quarantine protocols may work well for one facility while the same protocol may not be easily administered in others due to differences in institutional requirements, keeper experience and the availability of resources. The methods used by the Quarantine Team at the John G. Shedd Aquarium were developed and tailored toward the animals' needs based on our current knowledge of diseases, good record keeping, aquarist experience and skill, and understanding of the limitations of our facility.

Bernadette Maciol
Necropsy Techniques in Fish

Posters

Feeding Large Exhibits through Volunteer Diver Video Training at the Aquarium of the Pacific

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Aquarium of the Pacific

The Aquarium of the Pacific's largest exhibit is a 350,000 gallon tropical system called the Tropical Reef Habitat containing about 150 different species of fish. We feed our sharks, turtles, and most of our rays from the surface but the majority of our animals are targeted in the water by divers. To help feed our diverse collection, we enlisted the help of approximately 150 active dive volunteers. Previously, volunteer dive teams were primarily responsible for training new divers but their program did not include set standards and resulted in inconsistent and incomplete feedings. Each team had its own way of feeding. Many divers did not understand that importance of coordinating with each other and the surface feeders to ensure that more aggressive animals were occupied while targeting shyer ones. We decided to make a training video to instruct new and current volunteer divers on proper techniques for feeding and safe food handling practices. The training video has helped establish standards for volunteer divers and has ensured a more coordinated, consistent feeding.

Aquarium Fish Sanctuary Not for Profit

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Aquarium Fish Sanctuary

- Liaison service between the public, pet shops, private institutions, public institutions but limited to zoos and aquariums through education and communication.
- Accept or rescue fish that have out grown or no longer wanted by the different entities outlined above.
- Provide medical treatment to donated fish
- Open facilities to the public
- Offer classes to the public on aquarium keeping thereby fostering a positive impact on the community and local ecosystems

Final Editor's Note

The content of original manuscripts submitted to *Drum and Croaker* is not generally edited, although I will fix obvious problems if I find them. Articles not sent in the proper format (described in the "Hey Authors" section on the web site) are subject to more tinkering to "fix" them. Figures, tables and photos may be compressed, cropped or otherwise modified to save physical or file space, and photos, tables, and figures not referred to in the text may be omitted for the same reason.

I assume that all submissions have been authorized by all original authors or co-authors, and have successfully completed any internal review process required by your institution.