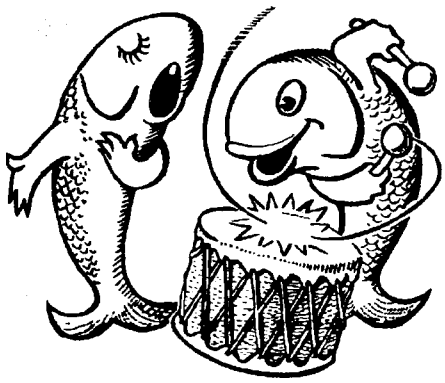
DRUM and CROAKER

A Highly Irregular Journal for the Public Aquarist



Volume 34 *Jan. 2003*

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DRUM AND CROAKER 30 YEARS AGO

Richard M. Segedi

(From D. & C. Volume 13 (72) Number 1, Edited by John G. Shedd Aquarium)

Upcoming ASIH Meetings, *Louis Garibaldi, New England Aquarium*

The American Society of Ichthyologists and Herpetologists meetings are to be held in Boston next June and the New England Aquarium has been asked to be a co-host. We have agreed to participate, but I explained to the local committee the present association of the professional aquarists with the AAZPA. It was felt, however, and probably with some justification, that there may still be some aquarists/ichthyologists (those with healthy budgets) who would attend the meeting as well as other researchers who are maintaining live animals for behavioral and ecological work. To provide a platform for these people and in the interest of grouping papers according to subjects or fields of interest Dr. George Myers suggested that a symposium be held entitled "The maintenance of lower vertebrates" with no illusion [sic] to aquariums as such or "Behavior and live animal care."

Recollections of AAZPA Meetings in Salt Lake City (9/19-23/71), *Daniel Moreno, Cleveland Aquarium*

It was my distinct impression that the aquarists were, for the most part, won over by the serious [sic] dedication, talent, and friendliness of the zoo contingent.

Although rather spontaneous, the aquarium faction did get together for a quasi-official meeting. . .

My most vivid recollections of the discussion revolved around the question as to how (and if) we were to join the AAZPA body. After considerable discussion, not without some differences of opinion being voiced, it was agreed (with a minimum of grumbling, as I recall) that we enterœwith no strings attached. Paul Montreuil was, I believe, "elected" to convey (orally) this information to the AAZPA...

To All Aquarists, *Editor, Drum and Croaker*

At the AAZPA meeting held in Salt Lake City during September, 1971, 19 aquarists from the United States and Canada met and discussed the problem of an annual meeting for aquarists. After considering the possibilities of affiliating with ASIH, MM, and AAZPA, or going it alone, those present voted unanimously in favor of AAZPA. They also decided that a program committee should be elected annually to plan the yearly symposium, and that this committee should endeavor to survey the aquarists of the USA and Canada each year in order to determine the type of program that the majority prefer and to increase the unity and communication between aquarists.

Little Known Fishes of the Potomac River, *Craig Phillips, National Fisheries Center and Aquarium*

VULTUREFISH, *Ichthycathartoides cathartoides*

A scavenger by nature, the vulturefish feeds extensively on fidoplankton (floating carcasses of dogs and the like), plus an occasional grapefruit rind to ward off scurvy. It spends most of its time secluded in waterlogged burlap bags and is seldom seen, which is just as well considering its unusually revolting appearance.

POT DARTER, *Etheostoma percolator*

Rusty teakettles and old coffeepots which line the substrate of the upper and middle Potomac are used as nesting sites by this fish. It should not be confused with the john darter *(E. brickhausi)*, which prefers cracked bathroom fixtures for this purpose.

CAPTURE AND FEEDING TECHNIQUES FOR PACIFIC ANGEL SHARKS, *SQUATINA CALIFORNICA*

Christina J. Slager, Curator
Kevin Lewand, Aquarist

Monterey Bay Aquarium, 886 Cannery Row, Monterey, CA 93940-1085

Abstract

Pacific angel sharks, *Squatina californica,* are seldom exhibited long-term in captivity due to the difficulties of inducing them to feed. We developed a capture method and a feeding protocol that has allowed us to successfully exhibit these unusual sharks. Using these methods we have been able to train Pacific angel sharks to eat either live or dead food, and we have successfully maintained individual sharks for more than two years in captivity.

Introduction

As part of an on-going program at Aquarium of the Bay (ABay) in San Francisco, California, focused on displaying challenging or seldom-seen animals in captivity, we developed a selective-capture technique and a protocol for rod-feeding Pacific angel sharks. These techniques, modified from field techniques described by Fouts and Nelson (1999), have been used successfully at ABay since 2000, and have subsequently been implemented at the Monterey Bay Aquarium.

The Pacific angel shark is an unusual, flattened shark, similar in appearance to rays. In the United States, they range from southern Alaska to Baja California. Typically, Pacific angel sharks grow to 1.5 m (5 ft) and up to 27 kg (60 lb). Historically known as monkfish because the shape of their heads resembles a monk's hood, Pacific angel sharks were once common. Currently, their population numbers appear to be declining due to heavy fishing pressure.

Collection

Pacific angel sharks are collected during the late summer and fall in Bodega Bay harbor, 65 miles north of San Francisco. They are found adjacent to riprap, cryptically buried in the sand.

To capture the sharks, three SCUBA Divers approach the targeted animal with two large nets and one large plastic bag. The diver with the bag positions the opening of the bag below the shark's head while the other two divers move the shark into the bag. This might involve gentle hand pressure or a quick, yet oh-so-careful, bear hug. Once the shark is inside the bag, the divers move the shark to the surface. The shark is then transferred to an igloo cooler for transportation to the aquarium.

Acclimation

The temperature and pH in the transport container are slowly adjusted to match the exhibit tank. Prior to introduction to the tank, the sharks receive a praziquantel bath inside the transport container (either 20 ppm for 1.5 hours or 10 ppm for 3 hours) and are visually inspected for other ectoparasites, especially leeches on or around the eyes.

Feeding Protocol

During the initial rod-feeding training, only live food is offered. Appropriate food is a live, juvenile sand dab, anchovy, sardine or other small, benthic fish supplemented with a multiple vitamin. Food is offered twice a week. The food fish is skewered on a thin, 30", clear acrylic rod with a small piece of electrical tape on one end. The tape prevents the food from sliding off the end of the rod. The rod is threaded through the mouth and out the operculum of the food fish.

The diver stealthily approaches the shark and positions him or herself on its anterior or posterior or lateral side. The diver controls the live food with the acrylic rod by moving food to the distal end of the rod and places the food above the shark's mouth at about the same distance as the length from its mouth to its pectoral girdle (typically 10-15 cm [4-6 in]), and perpendicular to the mouth. The food is wiggled back and forth until the shark lunges at and swallows it. This may take from five seconds to 15 minutes. If no eye movement is observed during the feeding attempt, the shark probably will not eat regardless of the duration of the feeding attempt. The food must be placed at the very end of the rod to help prevent the shark from biting and holding onto the rod. If the shark bites the food item and has also bitten down on the rod, the diver does not pull the rod away from the shark. The diver must wait until the shark either releases the rod or weakens its hold to the point where the rod can be carefully slid from its mouth. Typically it takes from two to eight weeks to train the sharks to eat from the rod. Once they are trained, the sharks can be switched from live to dead food.

Behavioral Considerations

The sharks will not eat if they are swimming in the water column; they must be settled in the sand. Also, the sharks will not feed if other large fishes are swimming in the immediate area (closer that one meter). If a feeding attempt is unsuccessful and the shark swims away, the shark will not eat until it resettles itself. Divers swimming after sharks in an attempt to cajole them to eat have not been successful. After a feeding fails, the next feeding is usually not attempted for at least 24 hours.

Although a non-feeding safety diver is always present during the feeds, the sharks have never displayed any aggression towards either the feeder or the safety diver.

Acknowledgements

The authors would like to thank the Husbandry Staff at Aquarium of the Bay and the Elasmobrach Team of the Monterey Bay Aquarium for their support. Also, we would like to acknowledge the assistance of J. Manuel Ezcurra, William R. Fouts, Michael J. Howard, Jeff Landesman, Colby Lorenz, Mike McGill, Andrew Sim, Freya Singer, and Reid P. Withrow.

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ABOUT THE ART OF *GYOTAKU*…

Bruce Koike, Director, Aquarium Science Program

Oregon Coast Community College, 332 SW Coast Hwy., Newport, Oregon 97365

Gyotaku (pronounced *Ghee-oh-tah-ku*) is the Japanese art form commonly referred to as fish printing or fish prints. The earliest known print is from the early 18th century. *Gyotaku* was originally used to record the types and sizes of fish caught by Japanese fishers. However, in the United States, *Gyotaku* has developed into an art form inspired by the technique of individual artist.

The fish prints in this issue of *Drum and Croaker*, were created using the "direct" method of fish printing. The direct method places the pigment directly onto the subject. A critical step in the printing process is specimen preparation. Prior to painting, the mucus coat is removed and the fish dried. I am familiar with of two references that live fish were used and "released unharmed"[1]. Once void of moisture, the paint can now be applied to the fish. Since the paper goes on the fish one time per print, you must paint the fish the way you want the finished product to look like.

Rice paper is the traditional paper used in Gyotaku. This paper is highly flexible, is strong even when wet, and is colorfast. Once painting is completed, the fins are pinned into position and rice paper placed on top of the fish. At this point, the fish and paper are "rubbed" together using your fingertips. Very little pressure is needed to transfer the paint onto the paper.

Gyotaku that is *w*ell done captures such characteristics such as fin rays, scales, well-defined mouth and lateral line. Eye stylization varies greatly; however, a skilled *Gyotaku* practitioner energizes a print through a masterful execution of the fish's eye, which gives life to the print.

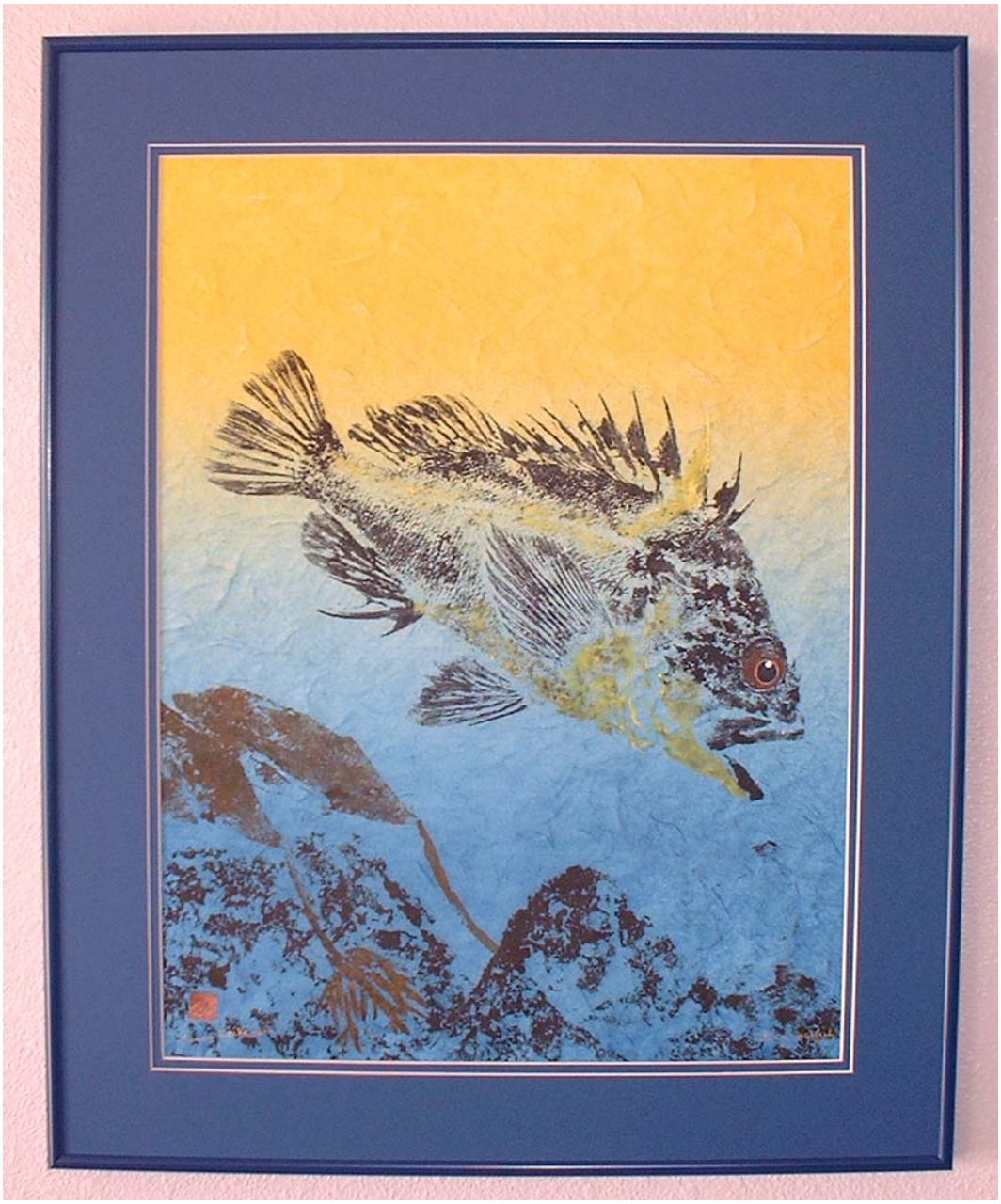
Because "rubbings" are individually printed, each art piece is unique, an original. Besides fishes, I have printed crab, shrimp, seaweeds, clams, mollusks, fishing lures and a shrew. Each print carries a *han*, and for my prints this means my last name written in the Japanese script known as *kanji*.

Once the printing session is over, specimens are rinsed off, wrapped in plastic and put back into the freezer. Other subjects such as albacore and salmon are rinsed and consumed-another appropriate use of the resource.

Our prints have been juried into several art festivals in Oregon during the past two years. We offer matted and framed originals, fish print apparel and note cards. I can be contacted at koikster@hotmail.com.

Footnote:

1 Apparently good artists but not knowledgeable fish culturists-though a recent story indicated that resource managers determined that there was paint underneath the scales of a non-typical colored fish.



About the Artist

Bruce Koike has been actively printing fish since 1993. His first fish print sale occurred during a staff and volunteer art show at the Aquarium of the Americas in New Orleans. The piece shown above (china rockfish) and our 2003 cover art (canary rockfish) are both his work.

He is currently implementing a two-year Aquarium Science degree program at the Oregon Coast Community College in Newport, Oregon. Students completing this program will have developed the skills to work with captive aquatic animal collections at public aquariums, aquaculture facilities, and ornamental fish enterprises. Other viable options after the program include transfer to four-year schools and entrepreneurial opportunities. For information about the Aquarium Science program contact Bruce at bkoike@occc.cc.or.us. Also see the survey results presented elsewhere in this issue.

ENHANCING THE EFFECT OF BACK-LIGHTED PANELS ON AQUATIC EXHIBITS

Justin Pierce

Audubon Aquarium of the Americas, 1 Canal St., New Orleans, LA. 70130

The use of backlit panels on exhibit aquaria has been steadily increasing in popularity, especially with sea jelly exhibits. A backlit panel is created by removing the back or sections of the back wall of an aquarium and replacing it with a translucent material. This material is usually light blue acrylic or stained glass that has been reinforced with clear glass or acrylic. An air gap between the two panes may or may not be used. Sets of fluorescent bulbs are positioned on the backside of the tank so that the panel is illuminated. When the tank is viewed from the front-side, the backlit panel with its glowing blue color creates the impression of peering into an endless body of water. This alone is a very dramatic display technique. However, there is a very simple way to enhance an existing exhibit utilizing this special effect. It is proposed that this method offers an innovative, easy, and inexpensive option to altering the appearance of aquatic exhibits in a realistic and captivating fashion.

Most backlit panels are intentionally uniform in color and intensity. This is dependent on the lights being placed far enough away from the panel so that the light from the individual bulbs cannot be distinguished. If they are placed too close, a banded pattern is created on the panel that ruins the effect. Since many support areas behind exhibits are very limited in available space, placing the lights at the proper distance could be problematic. One way to solve this is to mount a fluorescent fixture directly on the back of the tank facing downward. A large white sheet is suspended vertically behind the tank approximately 2-3 feet away. The primary function of the sheet is to serve as a reflective surface for the light, which illuminates the entire panel. The light is more intense towards the top and gradually tapers off in intensity towards the bottom, thus giving the impression of increasing depth. Optionally, an air-conditioner vent or small fan may be placed strategically so that it gently blows on the sheet causing it to ripple slightly. The minor differential intensity of light being reflected off the ripples in the sheet creates the illusion of glitter lines through the water normally created by the sun shining through the choppy sea surface. Thus far, the glitter line effect has only been tested on back-lit panels made of stained glass. The effect is probably more noticeable with backlit panels made of a more translucent material, such as stained glass, as opposed to a more opaque material, such as acrylic. However, the small price and ease of installation makes it still worth experimenting with using panels made of acrylic.

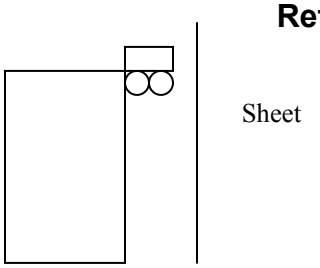
There are a few tricks to installing the suspended sheet. First, roll one end around a 1" PVC pipe that is the same length of the sheet. Use "zip-ties" to secure the sheet to the pipe by punching small holes and threading ties through the holes and around the pipe. Do the same for the other end of the sheet. Mount the top end high enough so that the bottom is suspended off the ground pulling the sheet tight. It may take some tinkering to get the sheet to ripple in the way that mimics glitter lines. Adding more zip-ties seems to create finer (and more realistic) looking lines. Too few zip ties will result in large areas in the sheet that are slack. The use of at least 1" PVC is recommended so that there is sufficient weight on the bottom to pull the sheet tight.

Using a suspended sheet in conjunction with backlit panels offers some advantages over the typical method.

1. It does not require the use of large amounts of space (un-used) between the fixture and the tank.
2. One light fixture can be sufficient instead of needing multiple racks of lights.
3. The effect of increasing depth can be created.
4. The dynamic effect of glitter lines can be created as opposed to the typical uniform and static look.

Typical configuration

Reflective sheet method



SALMON RETURN PROVIDES FOOD FOR AQUARIUM ANIMALS

Roland C. Anderson

The Seattle Aquarium

The Seattle Aquarium has a working salmon ladder at the facility. Each spring we release about 100,000 Coho and chum salmon fry and in the fall we usually get back about 50-100 adult salmon that jump up the 24 steps of the ladder from Puget Sound, an arm of the Northeastern Pacific, to a holding pond where they ripen before spawning (see Figure 1). But during the fall of 2001 the Aquarium had an exceptional return of chum salmon. Over a thousand chums leapt up the ladder, most of them within a couple days. The steps and windows of the ladder were clogged with salmon, much to the enjoyment of our visitors. This eventually led to a surplus of eggs and carcasses as the salmon were spawned. We dispatched the salmon to take their eggs since they are terminal spawners.

Normally we give our salmon carcasses to the nearby Woodland Park Zoo for food for their raptors and bears, but this year we filled their freezer. We also gave salmon to other zoos of the area and to local wildlife rehabilitators. Since we still had leftover carcasses, we looked for other ways to utilize them:

- Our educators were delighted with these salmon bodies and used them as demonstrations in salmon classes and for fish printing.
- The salmon were a source of food for our river otters and a means of enrichment, as they ate this natural food and played with the skin and bones.
- Salmon steaks, fillets, and pieces were fed to our other Puget Sound fishes.
- Salmon pieces were fed to our invertebrates such as sea stars, which did a remarkable job of cleaning the bones (see Figure 2.)
- Salmon were fed to our octopuses, which also became enrichment for them.

It was perhaps not so extraordinary that octopuses enjoyed the salmon. When we kept octopuses in our 400,000 gallon Dome tank, we occasionally saw an octopus catch a live salmon, snagging it by quickly wrapping an arm tip around the salmon. It was then fascinating to watch the octopus "reel in" the salmon, as the arm tip would be greatly stretched by the thrashing fish. What was not expected was the delicacy with which the octopus ate the chum salmon. They ate the flesh off the bones (see Figure 3) and the flesh off the tough, leathery skin, rather than chewing the bones and skin as might be expected, leaving the bones and skin in the bottom of the tank.

We can't explain why so many salmon returned in 2001. Perhaps the ocean conditions were just right or commercial salmon harvesters missed our school or a large school destined for one of our local rivers went astray (salmon are not infallible at returning to their natal rivers). Whatever the reason, the huge salmon return that year provided food and enrichment for many of our animals and others in captivity around the area, they provided our visitors with an dynamic display of returning salmon and they ensured their own species survival for future years.

Figure 1. The salmon ladder at The Seattle Aquarium allows returning adult salmon to leap up the steps of the ladder to a holding pool. Note the V gate at the bottom left that keeps the salmon from going back down.

Figure 2 (left). This is a male chum salmon jaw bone was cleaned and eaten by a sea star.

Figure 3 (right). This piece of salmon was eaten by a giant Pacific octopus, which ate the flesh off the bone

<INSERT AMUSING TITLE HERE>

Jay Hemdal

The Toledo Zoo

In looking through some early issues of *Drum and Croaker*, I noticed that there were from time to time, a few (albeit feeble) attempts made at writing aquarium humor pieces. For the last twenty years, these have fallen by the wayside, and it seems that we began taking ourselves rather seriously (considering that this journal was almost named *Grunt and Crappie*, there ought to be some continued deference to its potentially scatological origins). Since most of you folks don't take me too seriously anyway, I have less to lose in trying to resurrect this particular facet of D & C. The following is a mixture of a few original jokes combined with bits of humor that I found and filed the serial numbers off in order to call my own.

Frick: Did you hear about the anemone that was sucked into a powerhead and died?
Frack: Yeah, the strain must have been too much for it.

President Carter has always been interested in zoos. He was invited to go behind the scenes of a major zoo on a special V.I.P. tour. During the tour, he got a chance to see a manatee that was being held off-exhibit in a temporary tank for rehabilitation. Enamored with the creature, he confided with the curator that he had always wanted to name a zoo animal. The curator was chagrined because it was strict zoo policy not to give anthropomorphic names to their animals, but this **was** President Carter, so he relented to the request. President Carter observed the huge beast for a few moments, deep in thought, and suddenly proclaimed, "I will name you Hugh." The curator thought, "Well that wasn't too bad, no harm done by that." As the president and his entourage were leaving, he thanked the curator and exclaimed, "I can't wait to come back next year and visit Hugh again." The curator now had a big problem; he had to keep the manatee instead of releasing it as planned. You guessed it; the curator was now faced with the daunting task of building a habitat for Hugh manatee.

Where do *Lysmata* go to borrow money?
To the prawnbroker!

What happened to the shark that swallowed the aquarist's key ring?
He got lockjaw!

Aquarists Tom and Linda were admiring a new collection of fine Lake Erie carp in their quarantine system. As Tom leaned over the vat to get a better view, his wallet fell out of his pocket and into the water. They watched in amazement as a carp rose up from below and flicked the wallet back up into the air with its snout. Even more amazing was that a second carp caught the wallet on the rebound and sent it flying again with a nudge of its nose. This went on for some time, the two carp flicking the wallet back and forth between them. Tom remarked to Linda that this was the first time he had ever seen carp-to-carp walleting.

Why did the Limpet cross the road?
To get to the other tide!

A diver was coming ashore after a successful day of poaching lobster when a marine patrol officer came up, saw the bucket full of lobster and told the diver that the fine for poaching lobster was $500. "Oh, I'm not poaching sir; these are my pet lobsters from home. I'm just bringing them out for some exercise." "Exercise?" the officer said skeptically. "Sure, I bring them down to the beach, let them out for a little swim, then they come back and jump in the bucket and we go home." "Hmm, can you show me?" "Sure" said the diver as he dumped the lobsters into the surf. A few minutes later the officer said, "OK, let's see your lobsters climb back in the bucket" "What lobsters?" asked the diver.

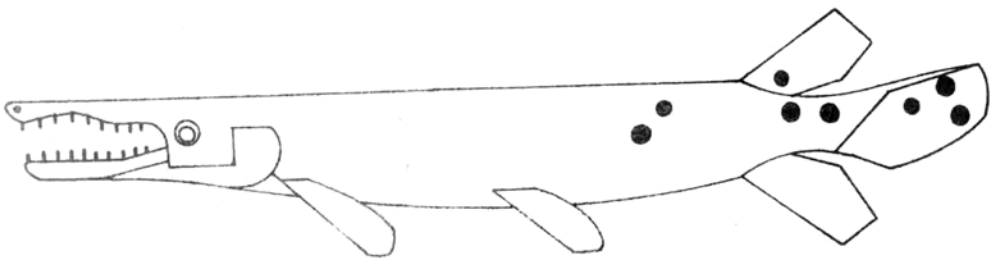
Q. What does a fish say when it runs into a brick wall?
A. Dam

Potential Science Fair Project: **"Forward vector analysis of *Carassius auratus* in response to vortex turbulence"**
- In other words, flushing your little sister's pet goldfish down the john?

Book review: **Interesting Fishes I Have Known, by I. M. Turbot.**
This author offers us some fascinating insight to the fishes of the order Pleuronectiformes. He certainly has a great eye for detail as is evidenced by this excerpt: "Its not a fluke, they didn't evolve this way just for the halibut, they obviously don't want to flounder through life; they have found their plaice. They just flat out want to be the sole fish with both of its eyes on one side of its head."

This fine material was brought to you by the following Aquarium staff members:

Jim Notas, Knifefish researcher
Di R. Knull, Daytime activities coordinator
Lou Fawe, Poriferan researcher
Lou Terr, Rapid equipment acquisition coordinator
Luke O. Sistick, Albinism researcher
Ben Z. Dreen, Productivity enhancement facilitator



Craig Phillips, 1970 Special Edition

THE SAGA OF THE DRUMMING KOB – A MUSICAL EXPERIENCE

Dr. Patrick A. Garratt, Curator

Two Oceans Aquarium, Cape Town

Contrary to a widely held belief, the sea is not a quiet place. Granted, there are vast areas of open water in which very little can be heard but, generally, where there is life, there is noise. Myriads of animals are communicating to each other, day and night, using sounds which range from the low frequencies of whales, communicating over thousands of kilometers, to high pitched squeaks and clicks emitted by small reef animals. In fact, reefs are so noisy that divers often locate them in poor visibility by sound alone!

In water, sound travels about five times faster than in air and it is widely used as a means of communication amongst fishes. Fishes detect sound with their lateral line receptors and their ears. The lateral line is used to detect relatively close, low frequency sounds, such as the sounds produced by the motion of fishes or other animals through the water. The ears of fishes, on the other hand, are sensitive to sounds from further afield and from a wide range of frequencies.

How, then, do fishes make sound and what do these sounds mean to other fishes? As indicated above, fishes make sound merely by moving through water! Clearly we are unable to detect these sounds, but imagine being able to hear a dense shoal of sardines or a shoal of large tuna swimming by! More important to the fish, however, is that these sounds may be the difference between life and death. The ability to "hear" the motion of other animals may be critical to both predators and prey, especially at night and in murky waters.

Some of the sounds used by fishes to communicate to one another are made, or amplified, using the swimbladder. The swimbladder functions mainly to adjust buoyancy but, by contracting muscles either in the walls of the swimbladder or connecting the swimbladder to the skeleton, some fishes are able to produce vibrations which can be heard as growls, grunts, hoots or drumming noises. The Kob (*Argyrosomas japonicus*) is one of these species and belongs to a family of fishes commonly known as "Drum".

As the name implies, drumming in Kob is nothing new, so why all the fuss when they start drumming in the Two Oceans Aquarium? The answer is simple. Even though some of us were aware that kob make drumming noises, none of us were prepared for the intensity of the drumming produced by our fishes. So intense was the sound, that musicians playing at evening concerts in front of our I&J Predator Exhibit threatened not to return until we had fixed our "mechanical problems".

It all started in the spring of 1998. At first the sounds were barely discernable, but I heard drumming early one morning in October and asked my assistant Curator, Simon Chater if he had heard it. Simon replied that he had heard it recently and thought that it may be our kob. The sounds were very intermittent though, and nothing to get excited about, so we left it at that. The next time we picked up drumming was in the following year. It was now louder and a few more

people in the building were aware of it, but they did not know what it was. Then one evening, at the beginning of one of our concert series, I attended a concert with my wife and the kob started drumming in earnest. Right in the middle of the concert! Heads turned towards me questioning what was going wrong and one of our staff supervising the concert leaned over my shoulder and asked politely what all the noise was about. I whispered that it was our kob making the noise and that they do this during spawning. This was met with a disbelieving look from the member of staff and my wife, who both thought that I was joking! The drumming increased in intensity and more looks came my way. I was quite comfortable with what was going on and just smiled reassuringly. I was, however, impressed with the noise that they were making. I had never heard such an intense drumming. The Kob continued throughout the concert and, immediately afterwards, I had a number of concerned people approach me. The harder I tried to convince them that it was the Kob, the more people thought that I was joking. Some thought that the Curator had "lost it".

Nothing more was said about the noise until the following concert. Again the kob started drumming in spectacular fashion and, on this occasion the musicians became quite irritated. The noise, which was similar to a large compactor or vibrating machine, was so intense that it was spoiling the performance. After the show, the musicians threatened not to come back until the "problem" was solved. In one sense we were fortunate. We had different musicians playing each week and we ran for a few more weeks with our Kob competing with the musicians. Our staff were, however, becoming increasingly concerned and called in the technical team to sort out the "problem". By now all the staff thought that the Curator had "lost it", as I was still adamant that it was the Kob making the noise and not a malfunctioning part of our machinery. Eventually, our technical manager, Vincent Calder, was called in to sort out the "problem". Vincent and his staff spent an entire evening shutting off one piece of machinery at a time in an attempt to isolate the "problem", to no avail! Eventually, Vincent started looking outside the building for the problem. Perhaps it was machinery used in the dry dock alongside us? What really fooled Vincent was the fact that he could hear the sound outside the building! Once he had discovered this, he was sure that I had "lost it". By this time I was keeping a low profile, saying very little. People were, once again, giving me strange looks.

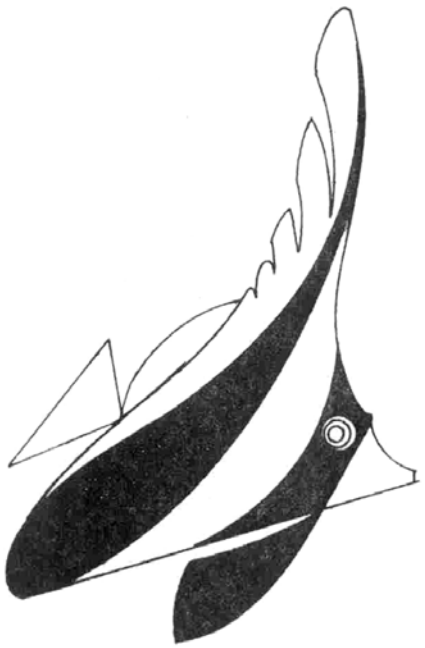
Vincent could not isolate the "problem" and we ran through the rest of the concerts with the Kob competing for attention. Then, one evening, I was vindicated! The Aquarium has an Aquarist exchange program and a visiting Aquarist was being shown around by one of our staff one evening when the Kob started drumming again. The Aquarist, Neil Major, put his hand on the main acrylic panel (which is 28cm thick) to feel the vibration and invited the visiting Aquarist to do the same. Luckily for me, on that occasion the drumming Kob were swimming alongside the main viewing panel and in no time at all, Neil had worked out that the vibration was coming from a particular fish! As the fish moved across the panel, one of them would move with it ,while the other stayed in position. Continuous reporting showed that the most intense vibrations remained within the vicinity of the fish and receded as the fish moved away from the starting point. Neil related the story to other members of staff the following morning and, whilst there was still a fair degree of sceptisism, others started 'following the vibrations' and the saga of the drumming Kob was solved. It was now my turn to give people the look which said "have a little

faith in your Curator". What a relief!

The Kob continue vibrating to this day. They are spawning successfully each year and we are producing eggs for scientists who are hoping to establish this species as a prime mariculture candidate in this country. The Kob continue competing with the musicians, but our staff are now quick to explain what is happening and our visitors are amazed and delighted. However, the story does not end here.

A local television station picked up the story and we were soon on TV explaining what was happening in the Aquarium and telling the story of how fish make sounds underwater. A week later I received a call from a little town on the west coast called Velddrift. Jan Kotze, who runs a farm and a few guest houses on the Berg River, was delighted to see our program because it may explain a peculiar drumming noise which can be heard each year, at a particular time,on and in the vicinity of the Berg River! He maintains that, on a still night, he can hear the drumming at least 100 meters from the river. He is now fairly convinced that the sound is coming from drumming Kob which are spawning in the river. Not so, say his fellow villagers in Velddrift. Everyone (in the district) knows that the sound is made by the "See Varkie", the sea pig. No one in the district has ever seen the See Varkie and no one knows what it looks like, but it is well known that it comes into the river each year! And anyway, what do those people in Cape Town know about fish and the sea? Absolutely nothing, as far as they are concerned.

A few years have gone by since Jan Kotze invited me up to his farm to hear the drumming and to make the aquaintance of the See Varkie. I think that the time has come for me to make that trip, and to learn more about the sea!



Craig Phillips, 1970 Special Edition

"WHAT EVER CAME OF THAT SURVEY WE FILLED OUT LAST YEAR?" RESULTS OF A NATION-WIDE SURVEY OF AQUATIC ANIMAL HUSBANDRY PROFESSIONALS

Bruce Koike, Director, Aquarium Science Program
Jane Hodgkins, Director, Professional and Technical Programs

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For millions of Americans, science centers, zoos and aquariums have become a major source of scientific information about the natural environment. The general population has, in recent years, had more of a selection of aquariums to visit. Of all the aquariums in the United States, approximately 30% began their operations since 1990. The industry's growth throughout the 1990's still persists as numerous international and American facilities are being developed.

Along with facilities coming on line, comes the need for staff. Early in the industry's history, individuals were hired based on their willingness to "dice and slice food" during the graveyard shift. A college degree was secondary and viewed as a value added benefit that happened to come with the 98.6^{o}F body temperature. Many individuals who started their careers in this manner have had a positive impact on the profession. In more recent years, graduates with a four-year degree were hired for aquarist, aquatic biologist, or animal care positions. Frequently though, these individuals initially lack the desired skills, experiences and perspectives that contribute towards being a productive member of the husbandry staff. Consider the following when a recently hired individual leaves your department:

- The staff lose their investment of time spent training that individual
- Possibly the unique skills and abilities of the individual were not harnessed
- The staff must adjust their work load and be work short-handed
- The Director/Curator must again justify hiring someone
- Resources must be spent advertising, reviewing resumes, contacting applicants and interviewing
- After arrival, staff must again invest their time to train new staff.

In response to this need for skilled personnel, the Oregon Coast Community College proposed and then received a three-year National Science Foundation grant to develop and implement a two-year degree program in Aquarium Science. This program will provide education and training to individuals who wish to work in the aquatic animal husbandry profession. Principle employment opportunities include public aquariums, aquaculture facilities, ornamental fish enterprises, entrepreneurship, or research facilities. Graduates will earn an Associate of Applied Science degree in Aquarium Science.

The nationwide survey that the college conducted in 2001 was the main piece of evidence used to justify the need for such a specialized study program. The survey identified the industry's need for trained personnel, the skills and knowledge that were lacking in recent department

additions and identified important skills and knowledge for students to acquire.

The survey consisted of two versions, one written for employers and one for employees. In total 1,420 surveys were mailed in September 2001 and accepted through November of the same year. Surveys were sent to individuals working at public aquariums, ornamental fish facilities, aquaculture enterprises and marine education facilities. The return rate was excellent with 43.3% of the employers and 65% of all employees completing and returning the survey. The response rate from public aquarium employees and employers was 82% and 77% respectively.

Employers were defined as department heads, senior managers and business owners. Over half of those responding (53%) acknowledged that they had experienced difficulty in hiring skilled, capable and knowledgeable individuals in the last 12 months. The skills that were most frequently reported as missing in new employees were both technical and general education in nature (Table1).

Table 1. Missing skills of recently hired staff (Employer survey 2001).

Missing Skills and Knowledge	Percent of Employers reporting in the affirmative
Subject Content Knowledge	82%
Related Job Experience	81%
Technical Skills	77%
Project Management Skills	63%
Oral Communications Skills	44%
Basic Science Knowledge	42%
Interpersonal Skills	40%
Computer Skills	37%
Writing Skills	30%
Basic Math Skills	23%

Employment opportunities for graduates of the program appear to be good. Slightly more than 50% of the employers indicated that over the next 5 years, their facility would require additional staff. Besides filling new positions, program graduates could also fill positions vacated by an individual. On average, employers reported that they had to fill 2.4 staff vacancies over the last year (range: 0-12 vacancies). The potential for people leaving the profession was determined through self-assessment. Of those employees who responded, 38% were uncertain about staying at their present career, while 8% acknowledge that they were going to make a career change.

Though job positions appear to be available in the near future, we had to determine if graduates of the two-year Aquarium Science degree (Associates of Applied Science) would be competitive for such positions. Although 30% of the employers reported that the minimum level of education required was a high school diploma or GED, close to 81% of the newest employees

had some college experience. Likewise approximately 96% of the current employees reported having college experience ranging from courses to advanced degrees. Of the four major industry groups surveyed, the least likely group to hire a program graduates were educational/interpretive centers (68%). In contrast, ornamental fish industry, aquaculture facilities and public aquariums were much more likely to consider Aquarium Science graduates as hirable (94%, 86% and 86% respectively).

In order to assess curriculum content, all recipients were asked to identify the skills and knowledge that were very important in their job. The following list is of the nine most frequently cited "very important" skills and knowledge items. These nine items were at the top of the list for both employers and employees (Table 2)

Table 2. Nine most commonly sited "very important" skills and knowledge by employers and employees (Employee Survey 2001 and Employer Survey 2001).

Daily Animal Care	Exhibit Maintenance
Record Keeping	Water Quality Management
Basic Science	Life Support Maintenance
Animal Health Management	Public Speaking
Knowledge of Current Job Topics	

The survey has provided a clear direction as to the delivery and content of study. The college operates on an eleven-week quarter system. Numerous comments were received as to the importance of hands-on technical experiences. With this input, the program will dedicate the last quarter for the student to complete a full-time internship. Presently, 30 aquatic facilities have indicated their willingness to host aquarium science interns. The existing infrastructure at each facility such as application form and paid/unpaid status will be adhered to. In an effort to improve the experience, each student will receive an evaluation from the internship coordinator. Likewise, the intern and the internship coordinator will evaluate the internship program.

The Aquarium Science Program wishes to thank all those who responded to the survey. Due to your input, reflection and participation you have directly contributed to the funding of an educational program that will have a positive impact on your industry and on people's lives.

To review both surveys in their entirety (18 and 17 question respectively) and the frequency analysis of each response, please go to www.occc.cc.or.us/aquarium science program/employer(ee) survey and responses.

We anticipate that the first cohort of students will begin their Aquarium Science studies during the fall term of 2003. Once the program has been approved by the Oregon Department of Education in December 2002, student applications can be accepted and reviewed. If you wish to obtain an Aquarium Science Program booklet and application, or desire to become an internship host facility, please contact: Bruce Koike at bkoike@occc.cc.or.us or (541) 574-7130.

FEEDING TECHNIQUES FOR THE PACIFIC TORPEDO RAY, *TORPEDO CALIFORNICA*

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Abstract

Pacific torpedo rays, *Torpedo californica,* are seldom exhibited long-term in captivity due to the difficulties of inducing them to feed. We developed a feeding protocol that has allowed us to successfully exhibit these unusual rays. Using these methods we have been able to train Pacific torpedo rays to eat either live or dead food, and we have successfully maintained individual rays for over two years in captivity.

Introduction

As part of an on-going program at Aquarium of the Bay (ABay) in San Francisco, California, focused on displaying challenging or seldom-seen animals in captivity, we developed a protocol for feeding Pacific torpedo rays. These techniques have been used successfully at ABay since 2000, and have subsequently been implemented at the Monterey Bay Aquarium.

Pacific torpedo rays (also known as electric rays) possess a kidney-shaped electric organ located on each side of their flattened disc. These electrogenic organs are used to capture prey and fend off predators. Torpedo rays are obligate piscivores. (Bray and Hixon, 1978). They capture and orient their prey head first during ingestion. Maximum electric organ discharge (EODs) for one torpedo ray in the field is 45 V (Lowe, Bray, and Nelson, 1994). In the Eastern Pacific, they range from British Columbia to Baja California with a depth range between 3–196 m (10–647 ft), and attain a maximum length of 1.4 m (4.6 ft; Michael, 1993). They are ovoviviparous with an estimated fecundity up to 17 young per litter. Maximum age is estimated at 24 years (Neer, 1998). They have no known predators, but there is a small fishery for neurological studies (Love, 1996). Long-term studies of this species have been unsuccessful due to their refusal to eat in captivity (Michael, 1993; Neer, 1998). Therefore, developing feeding techniques in aquarium and laboratory settings would be beneficial to learning more about this species.

Collection

Pacific torpedo rays are collected as bycatch from local fishermen using lompara or purse seine nets. Juveniles are also collected via SCUBA using plastic nets in Monterey Bay.

Acclimation

The temperature and pH in the transport container are slowly adjusted to match the exhibit tank. Prior to introduction to the tank, the rays receive a praziquantel bath inside the transport container (either 20 ppm for 1.5 hours or 10 ppm for 3 hours) and are visually inspected for other ectoparasites.

Feeding Protocol

During the initial rod-feeding training, only live food is offered. Appropriate foods for smaller rays are live anchovies or other small, benthic, fish, and for larger rays, sardines or surfperch are offered. All food is supplemented with a multiple vitamin. All prey must be offered with its head facing the mouth of the ray (they always swallow fish in this direction). Food is offered two times a week.

To feed adult rays in Abay's larger display (350,000 gallons), a monofilament line is threaded into the feeder fish via the animal's mouth and exits the operculum. One end of the monofilament line is tied to a black PVC pole held in one of the diver's hands; the other hand holds the end of the monofilament line. The prey is offered to the ray while it is resting on the sandy bottom. The prey is placed under the ray, near its mouth. The ray senses the food underneath using its ampullae of Lorrenzini and begins to release EODs as it undulates its body over the prey. The ray cups its pectoral fins over the prey, continuing until the food has been consumed. After two weeks of feeding live food, we switch to frozen sardines and use a 48" tong for feeding. The diver must hold the fish so the head faces toward the mouth of the ray, and the diver must continually move the food to simulate a live food item. (Note: It is very important to keep the prey moving while feeding frozen food or the ray will not swallow the food.)

To feed smaller rays in smaller tanks (*i.e.* 8-ft. cylinder tanks), the ray is initially lifted up in the water column using a soft net. The feeder uses 20" tongs to hold the prey offered. This is accomplished by clamping the tongs near the caudal peduncle of the prey. The feeder then offers the prey head first underneath the ray near its mouth. The ray will sense the prey and begin cupping the food into its mouth as described above. Again, frozen food needs to be moving in order for the ray to swallow the prey completely. If the ray still refuses to feed after many attempts, the feeder can invert the ray into a small, soft net and place the food into the mouth. The ray will slowly ingest the food on its own.

Behavioral Considerations

If larger torpedo rays (total length greater than 60 cm [23 inches]) are placed in smaller tanks they do not seem to survive long term, possible due to the rays need to roam and forage frequently. Rays that discontinue feeding should be checked and treated for parasites, especially monogenetic flukes within the gill filaments. Larger rays placed in tanks with other species may injure and possibly kill cohabitants. Divers must be aware of their location within the tank while doing maintenance, as rays will deliver a minor shock to the unsuspecting diver.

Acknowledgements

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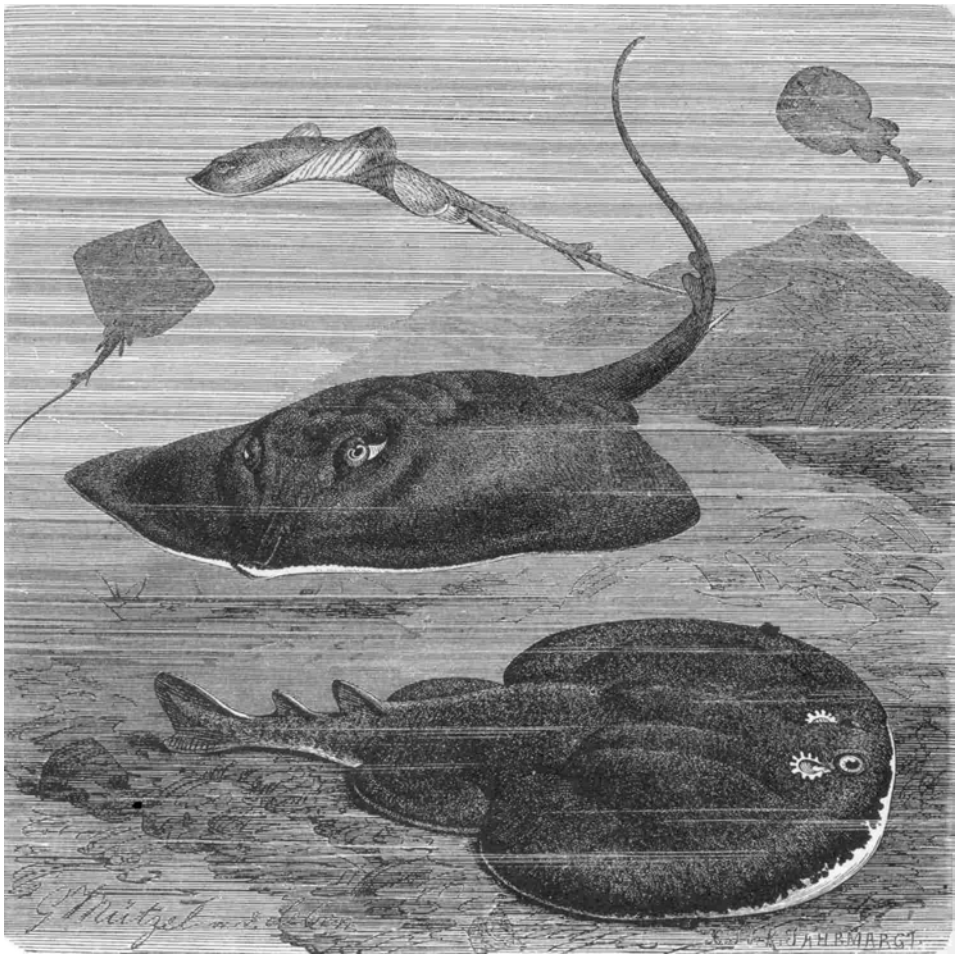

CURRENTS AND SURGE AND TIDES, OH MY!

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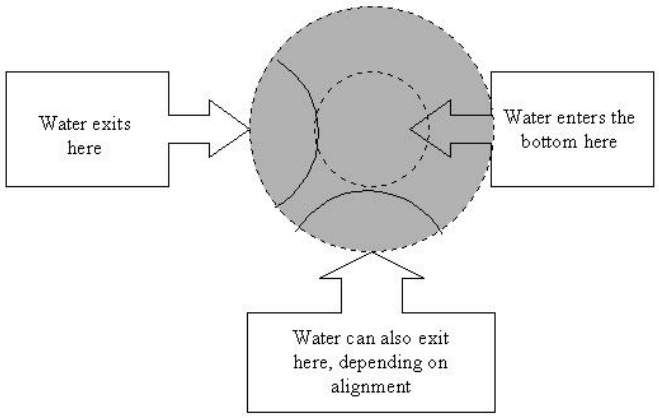
This is not intended to be a comprehensive review of surge generation in closed systems. If it were we would need to cover a lot more than the author has time to write about including Carlson Surge Devices, RCSDs, dump buckets and piston driven wave makers. What the author is trying to cover is the use of actuators and a different sort of valve that he finds quite useful. There was some discussion of these designs on-line and the author wishes to thank anyone from the Aquaticinfo and Reefkeepers on-line communities who helped or commented.

In 2000 we began a series of structural repairs to our exhibit gallery areas here at NEAq. One of these had the potential to force us to remove the CSDs (for the non-coral keeping crowd these are gravity drain tanks that use a self-starting siphon to create chaotic water motion, a.k.a. surge) from our 1000-gallon (3800l) live coral exhibit. The involved aquarists went in search of a low profile alternative. In the course of my research I spoke with some folks at Asahi America.

Their recommendation was an actuated valve setup. Initially I was hesitant about using actuated valves to control the full flow of a 1.5 hp pump. All I could picture was ending up with one valve stuck shut and then a second valve closing…then BLAMO…busted pipe, water everywhere, corals dying and aquarists getting middle of the night phone calls.

The Asahi representative brought a double L ported multi-port valve (see sketch of valve ball at lower left) for me to look at and showed me how it allowed the water to always have some place to flow throughout the actuation cycle. This particular version of the multi-port valve (see photo at lower right) allows water to enter the valve from the bottom and be directed either left or right. As the valve actuates from one side to the other water flows through both paths. As the

Top view (looking down) of center ball of double L ported valve



valve handle completes its 180° throw, flow is gradually cut off from the non-selected side. With the valve oriented to the left (for example) the right side is watertight. This combination of pump safety and good seals allows for several possible uses that will be discussed later in the article.

The system does have a drawback – cost. Based on 1.5" PVC plumbing setup you are looking at $188.00 (from Utilities Supply) for the valve, another $421.58 for the actuator (also from Utilities) and $89.00 for the repeat cycle timer (#T5 from Aquatic Ecosystems, pictured at left) plus the timer should be in a waterproof housing ~$30 to $60 depending on your source; plus plumbing and wiring the thing in place. The cost, for something the project manager considered temporary; the experimental nature of the design (we did not know of anyone using it at the time); and a flexible & creative mason, meant that we did not install the design. So it sat in a folder for a while.

Several months later I mentioned the design to Warren Gibbons, president of Gibbons Aquaria (a local, high end aquarium maintenance and installation contractor, staffed by a few former and present NEAq aquarists), as a possible solution to an installation problem for a new account. This account is a 500-gallon (1900 l) live coral exhibit in the lobby of the newly constructed Phelps Science Center at Phillips Exeter Academy in Exeter, NH (Photo below, right). The tank is wrapped by a staircase on two sides, in the middle of a several-floor atrium with the LSS in a small space, lower than the tank, under the stairs. All the pluming had to be laid under the Terrazzo floor before the tank was delivered. Warren was looking for a quiet system to vary the flow in the tank that would not generate the usual salt creep and bubbles associated with the traditional CSD design. Plus he did not have the space, elevation or tank free board for the CSD either. This tank has been operating with this surge system for approximately 1 year. See detail photo below (left).

NEAq has now also installed the same surge design on a 250-gallon (950 l) Solomon Islands lagoon tank in our Living Links special exhibit (see detail photo below). This tank sits about 25 feet from it's LSS in an open concept exhibit (again no overhead space for a CSD tank). The tank also features both through the glass as well as top down viewing. In this case the bubbles of a CSD were not welcome. This tank has been in operation for approximately 6 months.

In both cases the actuated valve varies the current/surge direction in the tank every 6 to 10 minutes (timer setup hint: on= one direction, off= the other plus you'll need to adjust the limit switches in the actuator to get 180° of throw). While the flow is not as chaotic as two CSD's firing randomly, the frequent change in flow seems to be sufficient for good coral growth. In the Gibbon's Aquaria setup there is a second feed that provides a constant flow that is interfered with by the cycling flow. In NEAq's version all water that is returned to the tank is pumped through the multi-port. Within the period of time that these two systems have been functioning the actuated multi-port valves seem to be providing a good surge generation option. Using this setup for surge generation means you need to find an actuator with a high duty cycle or it will burn out.

Both NEAq and Gibbon's Aquaria aquarists are planning to use actuated multi-port valves for surge generation in the future. Especially where the bubbles, salt spray and noise from CSD's will prove to be problems. We will also continue to use CSD's where appropriate. I like their simplicity and low cost.

We have found some other uses for multi-port valves. Some of these have been built and others are only in the 'back of the napkin' design state.

First and foremost the valves offer a quick tie in to the system pump for attaching things like back up chillers, DE filters or emergency/end of treatment canister filters to hold carbon or resin. We're using this on the main system pump for the live coral exhibit. In the back of the napkin category I've got two more ideas. One involves a similar setup for simulating tidal current using a pump on high flow exhibits like our Eastport harbor tank. The timer module involved would allow for very precise tide timing. A second idea would be for regulating tide height by controlling flow to either a low tide bypass or a high tide Hartford loop. That got me thinking (while writing this article) about a Hartford loop with a series of actuated valves that

would open at varying intervals to control tide height.

For a 6-hour tide interval (representing New England waters) you would want either six or three actuated valves opening every hour or two. This would allow the height of the water to drop by either 1/6th or 1/3rd of the total drop instead of the all or nothing drop of the single valve version. The cycle would reverse for a realistic fill. This would seem simpler than the clockwork style tide height controllers that some folks have built.

Hopefully all this will get you folks thinking and generate some new designs.

RAW 2003

Riverbanks Zoological Park (Aquarium)

The Regional Aquatics Workshop is an annual meeting of Public Aquarists from North America and many other parts of the globe. RAW # 17 will be the first meeting in 6-7 years to be held within driving distance of a large number of facilities. We expect a crowd, so please make your reservations early. A small registration fee is charged to cover the costs of some meals.

DATES (2003):

Tuesday, June 3 -	Sea Turtle Symposium
Wednesday, June 4 -	AZA Aquatic TAG Working Meetings / RAW Icebreaker
Thursday, June 5 -	Half day of Paper Sessions / Trip to SC Aquarium in Charleston
Friday, June 6 -	Paper Sessions
Saturday, June 7 -	Paper Sessions
Sunday, June 8 -	Trip to Ripley's Aquarium in Myrtle Beach SC & First Annual Aquarist Olympics

HOST/CONTACT:

Melissa Salmon
Riverbanks Zoological Park (Aquarium), 500 Wildlife Parkway, Columbia SC 29210
803-779-8717 x1121, msalmon@riverbanks.org

HOTEL:

Holiday Inn: Coliseum at USC
Reservation Desk: 803-799-7800
Room Rate $75.00 per night plus 10% tax (no parking fee)
Reservations must be made by May 2, 2003 for Guaranteed Space and Rate

WORLDWIDE REVIEW OF THE GREY NURSE SHARK, *CARCHARIAS TAURUS*, AS A CONTRIBUTION TOWARDS ITS CONSERVATION IN AUSTRALIA. A BIBLIOGRAPHY

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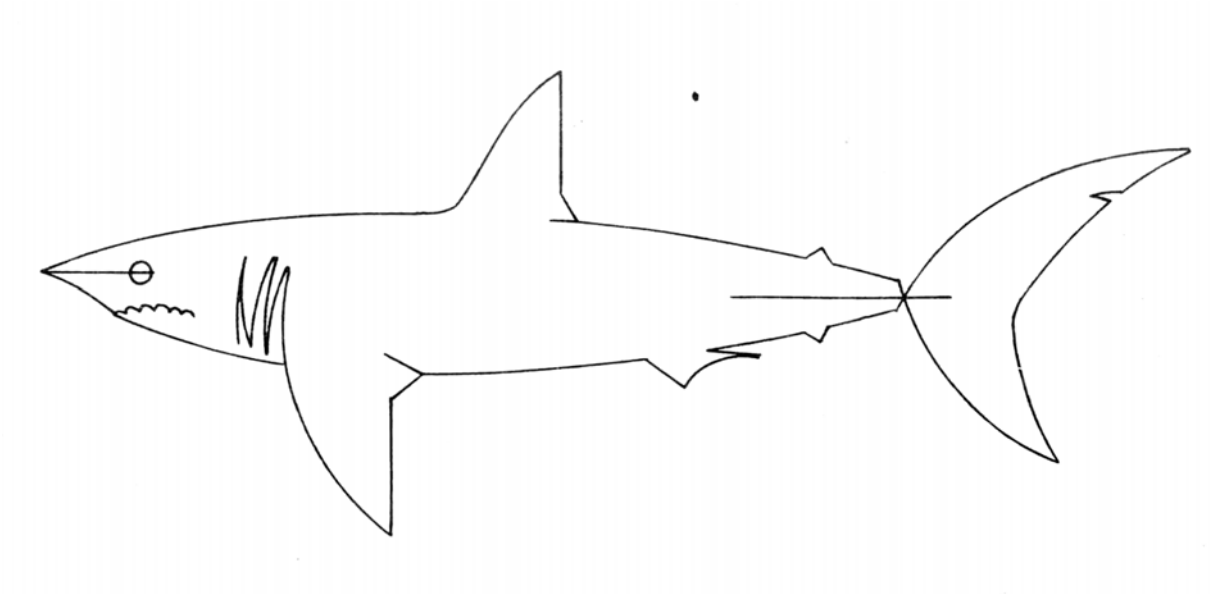

Craig Phillips, from 1970 Special Edition

BREEDING OF THE MARINE OSTRACOD *CYPRIDINA HILGENDORFII*

Liu Weibin and Bruce Mackay

Underwater World Singapore, Sentosa, Singapore

Ostracods are small crustaceans in the class Ostracoda. They are widely distributed in the sea and in all types of freshwater habitats (Barnes 1987). Some marine ostracods are bioluminescent, including a majority of those in the genus *Cypridina* (Zhenzhong, 1984).

Cypridina hilgendorfii is famous in Japan, where it is known as the 'sea firefly" (Oba *et al*, 2002). Its bioluminescence involves the oxidation of luciferin, which the ostracod releases into the water along with the enzyme luciferase. Its bioluminescence is considered to be primarily a defensive adaptation to confuse its predators, but can be artificially induced through sudden heat shock or electrostimulation.

In November 2001 Michi Amano of Tokyo Sea Life Park kindly provided an initial supply of *C. hilgendorfii* for use in a bioluminescence display at Underwater World Singapore (UWS). During the next few months a consignment of ostracods was imported every month to maintain sufficient stock for display. Unfortunately the ostracods were not available from Japan during late winter and early spring, hence we attempted to develop husbandry methods to maintain a self-sustaining population in order that the bioluminescence display could be shown year round.

For the past six months we have maintained a healthy breeding population of *C. hilgendorfii* to support our daily bioluminescence displays, and without the need to import any new stock. Our husbandry methods are described and discussed below:

Holding Tanks:

We use small glass aquarium tanks of dimensions approximately 70cm length, 40cm width and 40cm height. Fine sand (around 0.2mm diameter) is placed on the bottom of the tank to a depth of 3 cm. *C. hilgendorfii* usually lives in the top layer of less than 1cm. The ostracods bury themselves in the sand in the daytime, and emerge at night for feeding or mating. We maintain approximately 2,000 ostracods per tank.

Life support system:

Water is skimmed from the surface of the tank, passed through a bioball filter, and then pumped back to the tank. Make-up water is added during the day and not at night. Moderate aeration is applied in the holding tanks at all times.

Water temperature:

C. hilgendorfii can tolerate a wide range of water temperatures (10ºC -30ºC). The optimal range is between15ºC and 25ºC (Amano, 2001). At UWS, a chiller is used to maintain water temperature between15°C and19ºC.

Food and feeding:

At UWS, finely chopped fish livers from *Selar crumenophthalmus* are used as the main food, chopped fish meat is sometimes used to supplement the diet. Feeding is conducted once per day after the evening bioluminescence show. One fish liver (1.5-2.5g) is used for every 500 ostracods. On the following morning any left over food is siphoned away.

Light:

C. hilgendorfii is a nocturnal animal that will usually hide in the presence of light. At UWS the natural diurnal lighting pattern is followed and the holding tanks are shielded from all light during the night.

The method described above are newly developed, and not yet optimized. We are not aware whether the method will be suitable for long-term keeping of this ostracod. Even so, from our experience, we believe *C. hilgendorfii* is an easy animal to keep and breed, and we recommend it to our aquarium colleagues as a suitable animal to use in bioluminescence displays.

Acknowledgements:

We would like to thank Michi Amano of Tokyo Sea Life Park for her generous advice and provision of ostracods.

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BOOK REVIEW

AQUARIUM HUSBANDRY OF PACIFIC NORTHWEST MARINE INVERTEBRATES

Roland C. Anderson, Ph.D. 2001. 153 pp.
The Seattle Aquarium
$10.00 postpaid to U.S. Addresses

Reviewed by Jay Hemdal, Curator of Fishes, The Toledo Zoo

This paperback book was written by well-known marine biologist Dr. Roland Anderson, Puget Sound biologist for The Seattle Aquarium. Roland has seen that there is a distinct need for more comprehensive husbandry information for temperate and cold-water marine invertebrates of the Pacific Northwest. While picture books of creatures from this region are widely available, inland aquarists have few other resources to help them with their collection plans for these species. How often have you acquired an invertebrate from this area based solely on its color photo and **then** tried to work out its husbandry requirements after it arrived? This book will be instrumental in assisting aquarists in selecting invertebrates from this region that they will be able to care for properly.

Each of the fourteen phyla covered are described in two parts: general biology and husbandry. Over 250 genera of invertebrates from *Abarenicola* to *Zirfaea* are listed in the index. The natural history of the animals, including range, importance to humans, preferred habitat and reproductive strategies, is discussed first. Following this in the husbandry section is Roland's account of the proper care of that animal in captivity. One example is that of the slipper shell, *Crepidula.* I had always assumed these mollusks fed on epilithic algae as do the limpets. This book explains that they are actually mucus net feeders. Important display invertebrates such as deep-sea isopods and giant Japanese spider crabs not native to the region covered by this book are also discussed. In addition to the species accounts, three chapters cover an introduction to invertebrates, basic aquarium systems, general husbandry information and how to obtain animals.

Due to the lack of diagrams or photographs, the reader may also need one of the aforementioned picture books of animals from this region as a companion to this volume. A few grammatical and typographical errors will not detract from the usefulness of this book for aquarists.

The book is available directly from Roland Anderson at the Seattle Aquarium; 1483 Alaskan Way, Seattle WA 98101. Phone: 206/386-4346 or via email at: roland.anderson@ci.seattle.wa.us

BOOK REVIEW

CANDIRU
LIFE AND LEGEND OF THE BLOODSUCKING CATFISHES

Stephen Spotte, Ph.D. 2002. 322 pp.
Creative Arts Book Company, Berkeley, CA
ISBN 088739-469-8
$19.60 Barnes & Noble (www.barnesandnoble.com), $24.50 Retail

Reviewed by Pete Mohan, Curator of Fishes, Reptiles, and Invertebrates, Six Flags Worlds of Adventure

If the stories did not originate deep in the South American rainforest we would easily dismiss them as urban legends. After all, how likely is it that a small catfish could insinuate itself into smallest and most private body openings; resulting in agonizing infections, hemorrhaging, amputation of male organs, or death? Can these diminutive fishes really follow a stream of urine out of the water and swim upstream to your bladder? Since these intrusions are always fatal to the catfish, why do they occur? I mean *what is* this fish thinking?

Candiru is an accessible book for aquarists, biologists, and anyone simply interested in the more unusual aspects of tropical biology. Steve summarizes what is known about the rather confused taxonomy of the various Siluriform catfishes that are known as candirus. He has also gathered all of the (painful) reports of orifice-candiru interactions and attempted to distinguish between reliable records, hearsay, and distortions of the facts resulting from garbled translations and sensational retellings of "attacks".

While investigating the mysteries of candiru biology, and explaining what is known of their normal (non-urethral) feeding habits, the author reviews fundamental information on fish sensory systems, parasitism, and the special physiological adaptations required by successful blood-feeding vertebrates. He also describes the precautions taken by the local peoples when they bathe in waters infested with candiru. The latest styles in orifice plugs, shields, sheaths, and tourniquets are showcased, which I suppose is useful safety information to any of you who may eventually display these beasts. A snug-fitting custom wetsuit would also constitute adequate personal protective equipment, but where's the fun in that?

The last few chapters will be of greatest interest to the public aquarist. Steve's descriptions of his experiences collecting and studying living bloodsucking catfishes are both fascinating and entertaining. The final chapter, "Candiru World", could only have been written by someone who has spent some time building and theming public aquarium exhibits.

A BRIEF GUIDE TO AUTHORS

As always, Drum & Croaker articles are not peer reviewed and content will not be edited, other than to correct obvious errors or modify formatting. Other types of contributions may be edited to meet space limitations. **The approximate deadline for submissions is November 15th.**

Computer files are preferred to typed manuscripts. Please send a 3.5" floppy diskette or CD if e-mail isn't available. **My E-mail address is petemohan@aol.com.** Disks can be sent directly to: Pete Mohan, 5802 Thorndale Drive, Kent, OH 44240.

1. **"Regular" style articles**: All should normally follow the following basic format:
   TITLE (boldface, capitals & centered)
   one and one half space
   Name & title (centered & boldfaced)
   one and one half space
   Affiliation (centered & boldfaced)
   double space
   Text: single spacing with 1" margins. Please indent using a .5 inch tab stop at the beginning of each paragraph and double space between paragraphs. Section headings should be in bold (but not all caps) at the left margin.
   Figures: I can accommodate color photographs. It is helpful if the authors paste these into the text themselves. All photos should be formatted as low resolution jpg files, no larger than approximately 300 – 500 KB. Figures may be reduced to save space, and photos, tables, and figures not referred to in the text may be omitted for the same reason. Announcements may be edited where they are needed as filler at the ends of articles.

2. **Optional "Journal" style articles**: (I can forward you guidelines provided by George Benz, Tennessee Aquarium) [also see his article, "Morphology of the Fish Louse" in Volume 27]. This can be used to give your article a more formal appearance suitable for reprints. For a copy of the directions for this format please contact me at the above street or E-mail addresses.

3. Short contributions ("Ichthyological notes") are any articles, observations, or point of interest that are less than 1½ pages in length. A brief bold faced and capitalized title should be centered, text should be single spaced, and author and affiliation should be placed at the end of the piece with the left end of each line at the center of the page. Reformatting to meet guidelines for margins, etc. may reduce a shorter "main" article to a note.

4. Reviews, abstracts, translations and bibliographies are welcome.

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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.