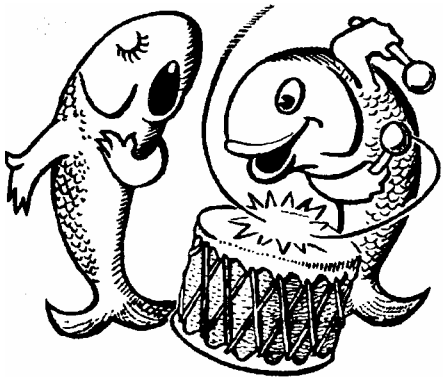
DRUM and CROAKER

A Highly Irregular Journal for the Public Aquarist



Volume 30 *Feb. 1999*

TABLE OF CONTENTS

SHORT COMMUNICATIONS AND ANNOUNCEMENTS

DRUM AND CROAKER 30 YEARS AGO

Rick Segedi

Cleveland Metroparks Zoo

The following excerpts are from Volume 3, September 1968, published by National Fisheries Ctr. and Aquarium, Washington, D.C. Craig Phillips, editor.

From: Miami Seaquarium Receives Killer Whale

On May 16, the Miami Seaquarium welcomed a two-year old male killer whale which was flown from Seattle in a Flying Tiger Line cargo plane. The flight took about 8 hours, during which time the whale rode in a custom-made cradle lined with fleece where he was kept moist by Seaquarium staff members. The whale was captured for the Seaquarium by Ted Griffen, Director of the Seattle Public Aquarium and is 12-1/2 feet long and weighs 1,800 pounds.

From: Philadelphia Underwater Museum

In April the world's first Underwater Museum was opened at the Philadelphia Maritime Museum, of which Theodore C. Leydon is director. The museum's collection of tools, artifacts, photographs, documents and models forms a unique history of man's activity underwater.

From: Experimental Tank for Pelagic Sharks David C. Powell, Sea World, San Diego

. . . The tank has been in operation for five weeks and at the present time it contains six blue sharks (Prionace glauca). These are all feeding and acting well. The first specimen introduced to the tank was a great white shark (C. carcharias). that weighed 120 pounds (54kg). It appeared to act well for six days, but deteriorated rapidly and died on the seventh day.

From: Rainbow Eggs Resist Big Bump

In December 1967 the Manchester National Fish Hatchery in Iowa shipped 200,000 rainbow trout eggs to the Crawford National Fish Hatchery in Nebraska. Weather conditions caused this shipment to be delayed in Denver, Colorado, but finally the eggs were placed on board an outgoing flight. Unfortunately, the plane crashed and several members of the crew died. The eggs, however, survived both 4 1/2 days in transit and the plane crash. They hatched at Crawford and are now doing well.

From: Recommended Standards for Tank Furnishings Other Than Fishes and Plants

1. Divers should be large headed and heroic of stance. Inclusion in the same tank as #5 below to be considered as dangerous.

2. Bubbles ejected from the mouth of ornamental frogs should be spherical, one inch in diameter, and released at regular intervals of 30 seconds. Bubbles passing out from the other end will be disqualified.

3. Sunken galleons must be small enough to look ridiculous when compared with the accompanying fishes, and must not be shown in marine tanks where they might appear more logical.

4. Glass marbles must be at least half an inch in diameter, the larger the better as more decaying food and other debris can be accumulated between them.

5. Mermaids will be judged in two parts. The upper half is to resemble as nearly as possible "B. B." [editor's note: for all of you youngsters out there, B.B. probably stands for Bridgette Bardot, a sex goddess of the 60's] but with the hair reaching to the waist. The lower half should bulge attractively at the hips, then taper off disappointingly to end in a caudal fin unlike that of any known fish.

GOBY RESEARCH AT THE NJSA

Alejandro Vagelli, Research Biologist

New Jersey State Aquarium, Camden, N.J.

(Portions of this work were presented at the 76th and 77th annual meetings of The ASIH.)

The genus *Elacatinus,* is endemic to the New World and is a component of what has been commonly called the American seven-spined gobies. The group comprises seventeen species, four of which are found off the Pacific coast of North and Central America, with the remainder inhabiting the insular province of the Western Atlantic from Florida to Northeast Brazil. This group of gobies is especially vulnerable to environmental disturbance because of several aspects of their ecology. For example; each species inhabits a particular micro-habitat and develops close associations with specific components of the reef communities, i.e., sponges, coral heads, crustaceans, several species of fishes; gobies combine a planktonic-dispersing phase, a larva stage, with a benthonic-non dispersing phase, a postlarva stage; gobies are demersal spawners, pairing for the care of the eggs for several days, before hatching occurs; and some *Elacatinus* species seem to have ecological or geographical reproductive barriers rather than genetic ones. These ecological characteristics make this group of gobies an excellent model for studies on biodiversity of coral reef ecosystems.

A new species of goby was discovered in an Aquarium tank

In 1995 we received several specimens of *Elacatinus oceanops* (neon gobies), which are known to be very efficient at removing ectoparasites from other species of fishes. Since this species had previously been bred and reared in captivity, it was decided to reproduce them. The goal was to use neon gobies as potential bio-controls of ectoparasites in our Caribbean exhibits at the New Jersey State Aquarium. A few months later we received another species of *Elacatinus,* which we called "golden gobies," referring to the color of their conspicuous longitudinal stripe. Determining the taxonomic status of these gobies was our priority, but their identification was problematic. Some difficulties we confronted in identifying this species were: a) The uncertainty of their geographical distribution (we never knew where these gobies came from, except "some place in the Caribbean"), b) The high variability of taxonomic characters found in both putative species, i.e., *Elacatinus xanthiprora* and *E. randalli* and their overlapping range (*E. xanthiprora* and *E. randalli* are the only two others species already described presenting a similar coloration pattern and overall characteristics with *E.*sp.) and c) The similarities and differences between taxonomic characters of *E. sp.* and both putative species, i.e., most characters overlap among the three species, however, some are distinct to *Elacatinus sp.* only. Finally, after several months of work, it was concluded that the golden gobies were likely to be an undescribed species. We had most of the necessary information to describe this new species except one important point, its geographic origin. Therefore, without a location type, describing it was not possible.

We began an intense search for the geographical distribution of the golden gobies, which ended in June 1996 at the 76th annual meeting of The American Association of Ichthyologists and Herpetologists. During a presentation on Brazilian coral reef ecology, a picture of a yellow-striped goby was shown. At that occasion, I predicted that this yellow goby was most likely a

new species, and probably our elusive golden gobies would belong to this Brazilian species. A few months later, the researcher that gave the talk informed us that in fact, the yellow gobies were an undescribed species. He described this species and he named it *E. figaro*. A comparison between paratypes of *E. figaro* with specimens of *E. sp.* was made in August 1997 and the result indicated that *E. sp.* and *E. figaro* belong to the same species. Thus after two years, it was finally proved that the golden gobies were, in fact, a new species.

Research on *Elacatinus* and related genera

The search for the identity of the golden gobies led me to general questions on several aspects of the biology of the genus *Elacatinus* and other related genera. I thought the genus *Elacatinus* could have gone through a rapid radiation, originating species adapted to different niches throughout the Caribbean. During this adaptive radiation, these species could have developed eco-geographical isolating mechanisms before developing the genetic ones. The result could have been a group of species genetically very close, perhaps even closer than the differences in morphological characters would suggest. To investigate if there was enough genetic similarity among these species, even to allow a hybridization process, we attempted to cross *E. oceanops* with *E. figaro* [1]. The result was viable eggs and a normal F_1 generation. This result indicated that these two species were genetically very similar and no ethological isolating mechanisms have been developed among them. Also, this cross suggested that only an allopatric distribution of these species would avoid the formation of significant hybrid populations in their natural habitats. The embryology of the hybrid was documented and a comparative analysis of the morphometric and meristic characters between the parental species and the hybrids was carried out. Continuing with the reproductive work, we bred and studied the embryology and larval development of the following species: *Elacatinus oceanops* (neon goby), *E. genie* (shark-nose goby), *E. puncticulatum* (red head goby), *E. figaro* (golden goby), *Elacatinus randalli (yellownose goby), Gobiosoma robustum* (code goby), *G. bosc* (naked goby), *E. evelynae* (cleaning goby), *Priolepis hipolliti* (rusty goby) and *Lythrypnus dalli* (blue-banded goby). Finally, as part of the tokological study, a standard was developed, based on pigmentation patterns, to identify larvae of different species of gobies and to compare developmental stages.

During these studies, two interesting observations were made. The first was that 90% of the hybrids do not reorientate during their embryonic development and this process is most likely genetically determined. The reorientation process involves a change in the embryo position inside the egg at about 48 hrs after fertilization, and occurs in all *Elacatinus* species studied.

The other observation was the correlation between aging females of several species of gobies and a reduction in the egg size. For example, *E. oceanops* normally lay eggs of approximately 2.4mm, but aging females produce eggs of only ~ 1.5mm. The embryos develop at a normal rate and to the normal size. After 5-6 days, the embryos become too big for the egg's capsule and this causes a radical bend in their body. As a result, the embryos have many difficulties in hatching, and those that can hatch, remain bent and die soon after that.

Currently, joint research is being conducted with Jim VanTassell from The American Museum of Natural History. The focus of this research is a phylogenetic analysis of the tribe

Gobiosomini. We are using ontogenetic information together with morphological and ecological data to interpret the evolutionary relationships within the tribe Gobiosomini[1]. In addition, samples of all the species listed above were sent for mitochondrial DNA (cytochrome *b*) sequences to produce a phylogenetic tree based on their genetic distants.

Next, we will continue studying the reproduction (including hybridization) on the rest of the *Elacatinus* species and their geographical distribution. Also, we will compare the results from molecular studies with those from reproduction-hybridization work.

The challenges ahead

The systematic and biogeographic studies done on these species, the lab results obtained on their reproduction, embryology and hybridization, and the "color phases" of some *Elacatinus* species mentioned in the literature, raise taxonomic, populational and evolutionary questions about this group. Are some *Elacatinus* species polytipic? Are there any polymorphisms within *Elacatinus* populations? How much intrapopulational variability exists? Are all the species previously described valid, or are some of them, parts of a semi-species complex, or a superspecies? Is there any natural occurrence of hybrids? How are the Atlantic species of *Elacatinus* related to the Pacific species? How is the genus *Elacatinus* related to the other genera within the tribe Gobiosomini?

The New Jersey State Aquarium has generated a considerable amount of data that helps to answer some of these questions. Nevertheless, to complete this study, it will require years of research on several aspects of the biology of *Elacatinus* and related genera.

By knowing more about goby life cycle, present geographical distribution, ecology and phylogenetic relationships, we will be in a better situation to understand the present status of coral reef communities. This basic information will be a valuable component of what is needed to develop successful conservation projects, and to create policies and legislation designed to protect coral reef ecosystems.

Notes on the hybridization between *Elacatinus oceanops* and *E. figaro*

Hybrids between *E. oceanops* and *E. figaro* were obtained. Two breeding pairs were induced to reproduce during a period of seven months in a non-choice situation. Only the cross of female *E. oceanops* x male *E. figaro* was viable. After 1.5 months, the first spawn occurred with a few scattered eggs and only two hatched larvae. Subsequent spawns were of better quality and rearing several cohorts to adult size was possible. Hybrid eggs hatch in seven days at 26 ^{o}C with 90% of embryos developing in an inverted position. After approximately 24 days larvae begin metamorphosis, becoming benthic and developing adult coloration. Unlike either parental species, hybrids present some chromatic polymorphisms.

The hybrids' embryology and larval development are more similar with *E. oceanops's* than with *E. figaro's.* Curiously, when adults are compared, hybrids are both meristically and morphometrically more similar with *E. figaro.* Hybrids are highly polymorphic with respect the snout mark (variations are in shape and position). Parental species are very constant in

coloration patterns, while hybrids showed some color variability, although it is more conspicuous during the juvenile stage. Hybrids did not reproduce. Despite that hybrids readily form pairs and have a well developed breeding courtship, so far no spawn has occurred. Preliminary observations suggested that the males produce normal sperm. In contrast, it seems that the females do not properly develop ovaries and, so far, no ovaries carrying mature oocytes have been observed.

Synopsis of the embryology and larva development of *E. oceanops, E. figaro* and *E. oceanops x E. figaro*

	E. oceanops	*E. figaro*	Hybrids
Devel.time (days)	7	7	7
Neurula size (mm)	0.8	0.6	0.8
Reorientation (hrs)	48	48	90%=no
1 chromat.migration (hrs)	85	85	85
Size at hatching (mm)	4	2.5	4
Yolk reabsorption (hrs)	24	24	24
2 chromat.migration (days)	3	3	3
Flexion (days)	4	5-8	4
3 chromat.migration (days)	24	28-30	24
Settlement (days)	24-26	30-35	24-26

(continued on page 7)

1999 NATIONAL FRESHWATER MOLLUSK SYMPOSIUM

The Freshwater Mollusk Conservation Society's 1999 symposium will be hosted by the Southeast Aquatic Research Institute (SARI) and the Tennessee Aquarium on March 17-19, 1999, at the Clarion Hotel in Chattanooga, Tennessee.

The following web sites have lots of more detailed information about the conference:
http://www.sari.org/MUSSEL_SYMPOSIUM_ANNOUNCEMENT.org
http://www.chattanoogaclarion.com/ (Clarion Hotel Reservations)

Chris Coco, the Curator of Fishes at TA can be reached at the following addresses:
Chris Coco, Tennessee Aquarium, PO Box 11048, Chattanooga, TN 37401-2048
Voice: (423)-785-4069. Fax: (423)-267-3561 E-Mail: csc@tennis.org

Character comparison between parental species and hybrids

Hybrid's morphometric characters: from a total of eleven characters, four showed an intermediate value with respect to the values of the parental species, and seven characters showed different or equal value to the parental species values (5 showed a bigger value than both parental species, 1 showed a smaller value than both parental species and 1 showed the same value as one parental species). Six of the seven non-intermediate characters have a value closer to *E. figaro* and only one character closer to *E. oceanops*.

Hybrid's meristic characters: all the fin ray counting values are intermediate. Hybrids do not present frenum (same as *E. figaro*). Lateral line pores as well as teeth do not show clear associations, although teeth-fangs disposition in hybrids is closer to the *E. oceanops* condition, and the pore distribution in hybrids is more similar to *E. figaro*'s.

	E. figaro male	*E . oceanops* female	Hybrids N=5	
			mean	c.v.%
Standard length (mm)	32.7	39.2	27.6	8.1
* Head length	26	24.2	25.1	6.0
* Depth at dorsal fin origin	20.1	20.9	18.5	7.9
* Caudal peduncle depth	12.5	11.7	12.2	3.0
* Eye diameter	6.1	5.8	7.3	4.3
* Snout length	5.5	7.4	6.4	7.2
* Upper jaw length	9.1	7.6	9.3	10.1
* Pectoral fin length	17.1	30.8	19.1	3.4
* Ventral fin length	14.3	11.9	15.3	6.0
* Ventral frenum	3.6	3.7	5.3	11.5
* Postorbital length	14.3	13.1	14.3	4.1
* Caudal fin length	16.5	16.2	18.1	7.5
Second dorsal fin rays	11	12	11.2	3.5
Anal fin rays	10	11	10.2	3.9
Pectoral fin rays	18	16	17.2	4.3
Frenum	No	Yes	No	
# Stripe index	36.3	31.7	37.8	
Fangs upper jaw	3	No	No	
Fangs lower jaw	4	No	M= 2-3, F.=3-4 enlarged teeth	

*Expressed as % of standard length

#Colored stripe width / depth at dorsal fin origin x 100

SHARK TAILS

Suzanne Gendron

Sea World Indonesia
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Having grown up in the era of Jaws, I thought I had heard all the variations on shark stories that were to be told until I moved to Indonesia. Then I started to hear about large sharks that ate bats. Impossible, one is of water and one is of the air. How would the two ever meet?

It was still the first year after SeaWorld Indonesia opened and finding sharks had not been easy. We had tried transporting Grey Nurse sharks from Australia but they were too old to tolerate the constant higher temperatures that are found in our waters. We had spent a week in Sunda Straits long lining for sharks; only to catch one ray, two groupers and a moray eel. Where were these elusive large sharks that everyone kept telling us about?

So you can imagine my curiosity and excitement when I heard from a number of sources that there was an island between Labuhan and Lampung where the sharks ate bats and these sharks were BIG! I had to see for myself.

As it was a private island, permission was sought to land on the island and a date was set. Before the pale rays of dawn crept over Jakarta, we were already on our way heading west to Merak. The SeaWorld Indonesian collecting boat was standing by, waiting to pick us up and chug us away over to this mysterious island.

Sharks that eat bats? Right. I have read many natural history descriptions of sharks and not once have I seen "bats" listed under their diet! Fish, squid, invertebrates, even marine mammals but never has anyone classified "bats" as a marine mammal.

Anticipation grew as we churned the hour over to Pulau Siangiang. I was ready to see this incredible phenomenon. But nothing is done without ceremony, nothing as momentous as discovering bat-eating sharks and so we began with a leisurely breakfast on the beach with our hosts. Stories were exchanged, donuts passed and the sun rose higher in the sky.

Finally we climbed into the long low perahu to gently motor through mangrove swamps, over to another side of the island where we would be able to land again and easily hike to the caves. This was even more intriguing. We were to see these sharks in caves inland?

It was a long way to come to have someone pull my leg! There must be an explanation.

It was a hot humid half hour hike in coming that explanation. Suddenly, we cleared the bush and descended from a rise to face a large cave. The whine of bats could be heard before we could even see within its depths. And there was water lapping at our feet as gentle waves rolled through the cave. This cave connected with the sea!

We watched the bats, surprisingly active at mid-day, fly from one side of the cave to the other; soaring and gliding. Still, I couldn't imagine how a shark could jump from the water to catch this beast of the air until a large wave came crashing through. An unlucky bat was caught unawares by the wave, wings wet, it fell into the water. Ah! There was a meter long Blacktip reef shark (Carcharhinus melanopterus), patiently waiting for this snack. With a smooth flick of its tail, the shark's jaws opened and closed, consuming the water logged bat.

As we watched for the next hour, twelve bats were eaten by the two sharks that patrolled this cave. Two bats were eaten by the excited dog that had accompanied us on this journey and none were caught by the monitor lizard that was cruising from a rock in the middle of the cave to the side and back.

Now if only the sharks had really been large!

JOHN H. PRESCOTT
March 16, 1935 - June 30, 1998

John Prescott, Director Emeritus of the New England Aquarium, passed away on June 30th at age 63. Before John's retirement in 1994 he was director of the aquarium for 22 years, where he oversaw the design and construction of a floating marine mammal expansion, and the broadening of the education and research programs.

In the *Boston Globe* Jerry Schubel, current president of the aquarium, said, "John Prescott provided remarkable leadership for the aquarium for more than two decades. He established standards of excellence across the institution which persist today". Rudolph Pierce, Chairman of the Board of Trustees, also noted that "Our success is his legacy".

John was an alumnus of Marineland of the Pacific, where he served in various management positions from 1957 to 1972. While at Marineland he edited *Drum and Croaker* during the mid-sixties. After moving to the New England Aquarium he again piloted "the Croaker" during the late seventies. John also served as an advisor to both the US Marine Mammal Commission and the International Whaling Commission. In 1997 He was given AZA's highest honor, the Marlin Perkins award.

John leaves his wife, Sandra (Baker); sons, Blaine and Craig; and stepsons, William and John Marsh. Thank you John, for your friendship and many years of service to the public aquarium field. We will miss you.

A HIGH PRESSURE AQUARIUM FOR DEEP SEA ANIMALS

David C. Powell

Monterey Bay Aquarium (retired)
1019 Short Street, Pacific Grove, CA 93950

The Monterey Bay Aquarium opened in 1984 and until 1996 all of its permanent exhibits focused on the aquatic life found in the near shore habitats of Monterey Bay. The two largest habitats off our coast and for that matter in the entire world, the open sea and the deep sea, were not included in these original exhibits.

In 1987, David Packard, the original benefactor of the aquarium, founded the independent Monterey Bay Aquarium Research Institute, known as MBARI <http://www.mbari.org/>. Its focus was to be research into the biology, geology, chemistry and dynamics of the deep sea environment of the Monterey Bay submarine canyon as well as the development of the technology necessary to achieve these research goals. To accomplish this the Institute was equipped with a land based building complete with laboratories, offices and machine shops, a 110ft. vessel and a remote operated vehicle, or ROV, capable of working at depths to 1,000 meters.

Shortly after the founding of the Research Institute the aquarium began planning a major expansion. We felt that if the problems associated with keeping open sea and deep sea animals could be solved that these would make exciting exhibits for our visitors and would complete the interpretation of all of the major habitats found near Monterey Bay. We realized this was a challenge and the husbandry staff began research programs into the capture, transport and keeping of both open ocean and deep sea animals. Our total exhibit expansion was planned to be a two stage process. Phase one, The Outer Bay, featuring the open sea, opened in March of 1996. Phase two, the Deep Sea, is planned to open as a special exhibit on the lower floor of the same building in March 1999.

We are very fortunate in being next to the largest submarine canyon in North America and to have the close cooperation of our sister organization, MBARI. We began our deep sea live animal research by setting up a number of holding tanks connected to two separate life support systems refrigerated to about 5° C. The animals we have been working with have been collected with MBARI's submersible as well as with midwater and bottom trawls and traps. We have been quite successful at keeping a number of species alive in cold water at atmospheric pressure and at saturated oxygen levels. The following are among the deep sea animals that have done well:

- Soft coral, *Anthomastus ritteri*. We have had individuals for well over two years and have had some successful reproduction.
- Sea anemone, *Liponema*. *brevicornis*. This striking looking sea anemone is found on the
- mud slopes of the ocean floor and is not attached to hard surfaces.
- Midwater eelpout, *Melanostigma pammelas.*
- Pallid eelpout, *Lycodapus mandibularis.*
- Filetail catshark, *Parmaturus xanuirus.* These deep sea sharks are doing well after six years.

- Chiton, *Psolus sp.* This filter feeding mollusk is very abundant on some areas of the canyon walls and rock outcroppings.
- Anomuran crabs, *Paralithodes rathbuni* and *P. californienses.*

In spite of these successes, there are many species that either did not live or died after just a few weeks or months.

One of the features of the deep sea off California is a layer of low oxygen between 500 and 800 meters where the oxygen concentration is extremely low. This zone, known as the oxygen minimum layer, can have oxygen concentrations as low as 1% of saturation. Even though the oxygen level approaches zero there are some animals that have adapted to these conditions

The life support systems for holding our animals were exposed to atmospheric air and are 100% saturated with around 9.0 ppm oxygen. We began to suspect that these high oxygen levels might have been toxic to those animals coming from the oxygen minimum layer. With this in mind we set up a separate life support system with low oxygen, specifically for those animals that in the past we had not been able to keep for long periods.

The system is designed to strip oxygen from the water by bubbling nitrogen through a contact tower in the recirculating water system. The water surface of the tanks is sealed with plastic sheet to minimize the absorption of oxygen from the air. The oxygen level is continuously monitored with oxygen sensors and the nitrogen flow adjusted automatically to maintain levels of one to three parts per million. This oxygen stripping system works well and we began to have more success with some animals that had not done well under the high oxygen in our original water systems. It became evident that oxygen at 100% saturation is toxic to some animals.

The predatory tunicate, *Megalodicopia nians* is a carnivore and captures and digests small crustaceans. Because of its uniqueness this remarkable animal was of special interest to us and we had been frustrated by its slow decline in our earlier aquarium system. Since keeping them in low oxygen we have some alive and healthy for over two years. This may be their normal life span. Two other animals, the sea pen, *Umbellula* and the cephalopod, *Grimpoteuthis* are also found in the oxygen minimum layer and we have hopes of being able to keeping them successfully under low oxygen.

Although progress had been made, there are still some invertebrates that have not done well even when given the same temperature and same low oxygen found at the depth that they were collected. We believe that we had provided these animals with all of the environmental parameters they needed except one. The missing environmental factor was pressure. We decided to investigate the effect of pressure and a high pressure chamber was designed for deep sea animals.

Following the K.I.S.S principle (Keep It Simple, Stupid), this first attempt at keeping animals under pressure was as simple as possible. We hoped to work with animals that we

believed could tolerate a short time at atmospheric pressure before being re-pressurized to a depth reasonably close to the depth they inhabit. Our goal was to collect the animals with the ROV and then to re-pressurize them as soon as they were brought back to the aquarium. Ideally the animals should be maintained at all times under pressure from the moment they are collected with the ROV all the way to the pressure chamber. Such a 100% pressurized system will no doubt be necessary for many animals and especially for those that live at greater depths than we are presently working. However, many problems can be solved using a simpler experimental model before tackling a technically very complicated 100% pressurized system.

The first animal we tried in the pressure chamber was one that we learned needs constant pressure to survive. Even a short period of time at atmospheric pressure was fatal to our first test species. A number of the remarkable deep sea holothurians *Scotoplanes,* were collected in excellent condition from a depth of around 1000 meters. Even though they were re-pressurized to 35 atmospheres within three hours of collecting they did not survive for more than a few days. This was the same length of time that unpressurized *Scotoplanes* survived. It appears that irreversible damage was done during the three hours that they were exposed to atmospheric pressure. Another animal that we had plans to test was the giant isopod, *Bathynomas gigantea,* It is found in deep water in the Caribbean and Gulf of Mexico and will live and feed at surface pressure for up to a year or more. However, at surface pressure it is much less active than those observed at depth from a submersible.

Following are the specifications and mode of operation of the chamber.

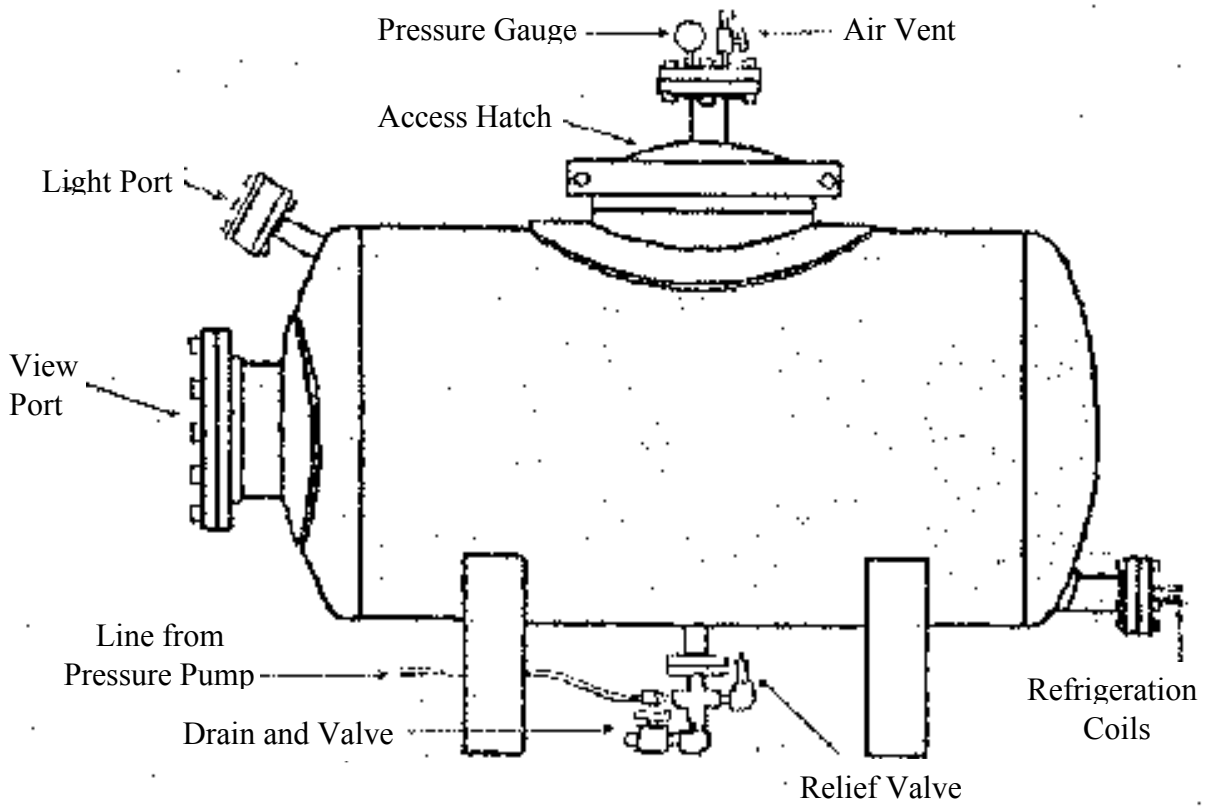
Dimensions: cylinder 1.8 meters long x 0.9 meters diameter
Pressure: 34 atmospheres, 500psi, depth of 350 meters
Volume: 1100 liters
Weight, 1200 kg empty
Weight, 2300 kg full
Material: 5/8" steel, powder coated epoxy
Flanges: type 316 SS and titanium
Chiller: 3/4 hp internal titanium coils
Operating temperature 5°C
Pressurizer: pneumatic powered seawater hydraulic pump

To prevent gas super-saturation when pressurized, the chamber is completely filled with seawater and all air is evacuated before pressurizing. A sealed, air filled compressible bladder of approximately three liters in volume is inside the chamber. This pressure reservoir helps maintain pressure in the event of a small water leak. The chamber needs a compressible space within the chamber to prevent a rapid drop in pressure in the event of the loss of a few drops of water. The chamber is initially pressurized with an air powered, stainless steel hydraulic pump pumping refrigerated seawater. Once pressurized to 35 atmospheres the pump is turned off and the chamber maintains pressure indefinitely. A small, 110vac, oil-filled submersible circulating pump is located inside the pressure chamber to circulate the water across the refrigeration coils and to provide filtration through a small cartridge filter. A pressure-proof oxygen sensing electrode is inside the chamber to monitor the oxygen concentration. Electrical power to the pump and the signal from the oxygen sensor pass through oil-filled urethane tubing to pressure proof electrical connectors in the tank wall. All flanges and fittings are sealed with neoprene O-

rings. The pressure chamber operates as a closed system with no continuous addition of new seawater. Water changes can be made periodically as needed to maintain water quality.

This experimental work is a first step towards reproducing the environment of the deep sea that could ultimately lead to the maintenance of deep sea animals for both research and exhibit. The pressure chamber will not be used as part of the Aquarium's Deep Sea exhibit in 1999 and it has been transferred to MBARI for their research work on deep sea animals.

Pressure Chamber



CULTURING THE MYSID SHRIMP, *MYSIDOPSIS BAHIA* AS AN AQUARIUM FOOD

Jay Hemdal

The Toledo Zoo

Various species of Mysid shrimp, (also known as opossum shrimp) have been collected or cultured as a live food for aquatic animals which prefer living foods, such as seadragons, seahorses and pipefish. Many other species of fish relish the addition of Mysid to their diet, but difficulty in producing these crustaceans in sufficient quantity generally relegates their use to only the most critical cases. The method described can produce over 2000 Mysidopsis bahia per week with a time investment of less than 45 minutes per day. Equipment cost is minimal, and the only operational cost of note for this system is the substantial use of Artemia naupulii as a food source.

Culture area:

Using a rearing area with 80 - 100 square feet of floor space, establish three 30 gallon aquariums and ten 10 gallon tanks with synthetic seawater (at a salinity of 21 to 22 ppt) and air-driven biological filters. It helps to pre-establish the bacteria in the filters by running them in the sump of another marine system for three to four weeks prior to this time. An Artemia system capable of hatching from 8 to 10 grams of cysts (dry weight) per day is also required.

Beginning the Mysid culture:

A starter culture of around 200 captive raised young adult Mysids is added to one of the 30 gallon brood aquariums. These are fed newly hatched Artemia naupulii "at liberty" twice a day. When they become sexually mature, their young are removed twice a day, just prior to each feeding. The young Mysids are housed in the ten gallon rearing aquariums at a density of between 1200 and 1300 per tank. A new rearing tank is started when the last one reaches that density. When all ten rearing tanks are filled, room for new baby Mysids is created by harvesting the oldest rearing tank and utilizing it as fish food. When the first tank of collected young Mysids reach 4 to 5 weeks of age, about 200 of them are used to set up the second 30 gallon brood aquarium. Continue collecting young from both brood tanks and then after another month or so, select another 200 young adult Mysids and use them to set up the third brood tank. The culture should now be at peak production. At some point, productivity in the first brood tank will start to decline as the Mysids reach old age. At that time, the old adult Mysids are removed, the brood tank cleaned and 200 young adults are selected from one of the rearing tanks and set up in the first brood tank. In this way, a fairly constant, highly productive culture can be maintained.

Husbandry:

Despite their widespread use as pollution bio-assay organisms, Mysids are not too demanding in terms of water quality (as long as the values remain within a reasonable range). No unusual mortality was noticed in tanks even when the ammonia concentration approached 1 ppm.

Average water quality for mysid culture tanks:

Temperature = 75 degrees F.	Light = 75 foot-candles
Salinity = 20 – 22ppt	Ammonia = 0.1 mg/l
pH = 8.2	Nitrite = 0.01 mg/l

Artemia culture:

Prior to being fed to fish, Mysids should be fed Artemia which has first been fortified with Super Selco. Fortified Artemia can be fed to the Mysids at every feeding, but since this is a very time consuming and expensive process, routine Mysid feedings can be done with "bulk Artemia" as follows:

Using an inverted, clear two liter soda bottle (with a cap) with a 1" hole cut in the bottom, add 6 - 8 grams of Artemia cysts, four tablespoons of sea salt and fill with tap water. Add an airline and harvest after 28 hours by removing the air line, letting the bottle settle, and slightly loosening the cap over another container. Let the settled naupulii run into the container, and tighten the cap back on before any of the empty cysts flow out. Strain the naupulii through a brine shrimp net, rinse with clean seawater and feed out immediately.

Hints and tricks:

Three models of sponge filter were tested: All became clogged with Artemia nauplii, and needed to be rinsed out in seawater every week or so. Eventually, the sponges became too clogged to be easily cleaned. Bio-filters were constructed using plastic deli cups, 1" rigid tubing and bio-media (figure 1) which did not clog as readily.

Various hydroids and other "pests" can show up, (mainly in the brood aquariums) and need to be removed by stripping down that tank. At the very least, these hydroids compete with the Mysids for food, and at the worst, they may actually consume juvenile Mysids.

When productivity is low, start up a new rearing tank after seven days, even if the target level of 1200 baby Mysids has not yet been met. The reasoning is that if there is more than a one week age difference, the older Mysids will prey upon the newly added ones.

Surplus adult Mysids can be frozen for later feeding, or added live to a large holding aquarium, as sort of a "rainy day fund".

The best way to remove larval Mysids from the brood tanks is by siphoning them out using a flame polished glass tube attached to a length of 3/16" airline tubing. With practice, an aquarist should be able to siphon out the babies at a rate of better than 20 per minute. The trick is to avoid wasting time trying to siphon out three or four day old babies, they are just too fast. Focus on the smaller one or two day old ones that are positioned on the glass of the aquarium. Free-floating babies are able to escape the siphon in any direction, making them harder to capture. Mysids crawling along the glass can only escape along a 180 degree plane, away from the siphon.

Although time consuming, productivity in the brood tanks can be enhanced by selectively removing most of the male Mysids. This reduces predation of the larva as well as the amount of

Artemia needed as food for the breeders. With a small net, capture the majority of the Mysids which do not show the female's white brood pouch. You may remove some non-breeding females with this method, but the majority will be males. Even a 10:1 ratio of pouched to non-pouched animals will produce well.

Mysids as food:

Most zooplanktivorous fishes relish live Mysids in their diet. Once accustomed to capturing the shrimp, most fish seem to feed on them with much more vigor than they show for other foods. In one case, two Red backed butterflyfish, (Chaetodon paucofasciatus) were first offered live adult brine shrimp. These the pair consumed at a calculated rate of 30 per minute. When the butterflyfish were then immediately offered live Mysid shrimp, they consumed these at a rate of 65 per minute. Some degree of caution may be in order as these butterflyfish attacked the Mysids with such ferocity that their snouts became bruised from repeatedly hitting the tank walls and bottom as they captured the shrimp. It is unknown if this vigorous feeding response is due to the good "taste" of the Mysids, or if the shrimp's swimming behavior more closely matches that of a zooplanktivore's normal prey.

Although the nutritional profile of Mysidopsis is not known by the author, anecdotal reports indicate that as a food item, they are vastly superior to Artemia in both acceptance and nutritional value. A group of new-born Hippocampus which had been fed Artemia nauplii for the first six weeks were gradually wasting away. Mortality ceased once small Mysids were offered as the sole food. Captive husbandry of seadragons requires ample supplies of live mysids, with no other substitute seemingly available (Paula Powell, Dallas World Aquarium personal communication).

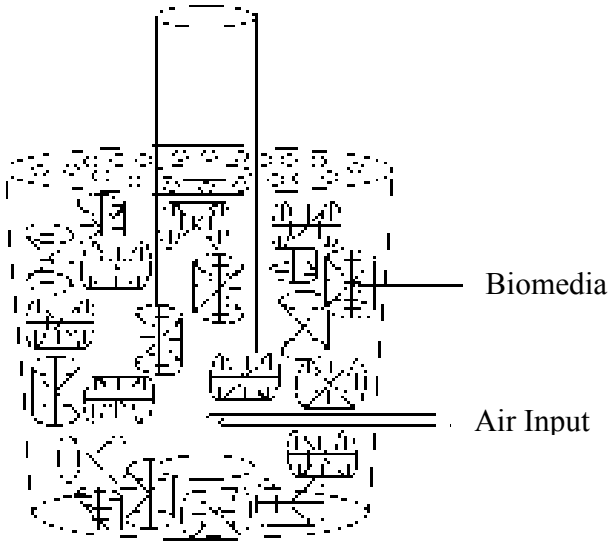


Figure 1. Biofilter

ACCURACY IN EXHIBITRY: DOES IT REALLY MATTER?

J. Charles Delbeek M.Sc., Aquarium Biologist

Waikiki Aquarium, University of Hawaii

In the last eight years I have visited approximately eighteen non-profit and for-profit aquaria in North America, and ten in Asia and Europe. During these travels one thing that struck me was that just about all of them went to great pains to make it clear that one of their primary mission goals was education. I think all of us hold this as one of the main justifications for the displays we construct and maintain, to educate the general public about the habitats, ecosystems and organisms of a particular area. That is why one prevalent trend I noticed left me rather puzzled; the collection of fish and invertebrates presented as "representative" of a particular biotope or geographical area were often inaccurate. In some cases the inaccuracies were minor but in far too many they were significant. This raises the questions: how accurate should our displays be? Should we even be concerned? After all, most people would not even notice these discrepancies. Is it worth that extra effort for the small percentage that would? These are the sorts of questions we need to weigh against a host of other considerations. Below are the three areas that most of the problems I have seen fall within.

Exhibit Design

Although exhibit designers have come a long way in creating natural looking habitats it is also obvious that there is still room for improvement. Of course exhibit designers are not solely to blame for this. As aquarists, I feel that we have an obligation to work with exhibit designers to ensure the exhibit is as accurate as possible. This can be as simple as making sure the rockwork looks like the area being recreated, to insuring that the assemblage of artificial decorations (corals, seaweeds, anemones, etc.) are appropriate for the area being depicted.

There are still some areas that need improvement. For example, I often see artificial corals placed in exhibits in totally unnatural orientations. Corals grow in response to light and water flow. When fabricators recreate corals they are making them into a shape that reflects a certain orientation in the wild. However, when placed in exhibits this fact is often ignored and they are placed in such a way as to contradict their natural shape.

Another problem is that the species assemblages of artificial corals placed in exhibits often contradict the theme of the exhibit. For example, in a recent exhibit depicting a tropical Pacific lagoon habitat, I found several pieces of *Pocillopora meandrina*. Unfortunately this species is normally found in high energy, surge-type habitats along forereefs, not in placid lagoons. In other exhibits, deepwater corals are sometimes shown in shallow water habitats or visa versa.

Exhibit Decoration

In smaller exhibits it is usually the aquarist who designs, constructs and maintains the exhibit. In some cases we inherit exhibits from other aquarists. In both these situations responsibility for exhibit accuracy falls to the aquarist. In one major aquarium I was looking at

two exhibits situated next to each other. One depicted a Hawaiian biotope, the other Caribbean. Unfortunately, most of the artificial corals and dried skeletons in the Hawaiian exhibit were species not found in Hawaii and some even came from the Caribbean. In the Caribbean exhibit many of the corals were of Pacific origin.

In the last few years we have seen a rapid increase in the use of live corals and more natural "minireef" type exhibits using live rock, sand and associated invertebrates. In these exhibits it is even more common to see coral species from completely different geographical areas and habitats in the same exhibit. Most of the live coral tanks I have seen have been merely collections of corals from a variety of habitats, with no apparent attempt made to recreate a certain biotope or geographical region. It seems as if the great care that is given to making large exhibits accurate is not being carried over to these smaller, living exhibits. Why is this? My impression is that these exhibits are stocked more in accordance with availability of specimens than habitat recreation. Despite the increased availability of live corals in the pet trade, most still tend to belong to lagoon genera (e.g. *Euphyllia* spp., *Trachyphyllia* sp.. *Catalaphyllia* sp.. etc.) and this is reflected in our exhibits.

Fish Collections

Now, you might be saying that it is only natural that the problems with corals and other decorations occur since so few of us have the necessary expertise to know what corals, seaweeds, or anemones belong where. However, I found that the most liberal interpretations, in the hundreds of exhibits I have seen, were with the fish assemblages. In some cases the fish had no bearing to the theme of the exhibit, in others the fish came from different oceans, in still others the fish in the exhibit were not normally found in the habitat being shown. For example, I have seen the newly "rediscovered" Banggai cardinalfish*, Pterapogon kauderni*, on display in numerous aquaria, and in 99% of the cases they were in coral reef displays. The problem is this species lives in seagrass beds, miles away from any coral reef. I have also seen the opposite where reef fishes were placed in an exhibit with artificial seagrass, presumably because they were colourful. In other aquaria I have seen fish that normally live below 100 ft. in the same display as shallow water schooling species.

What's Going On?

There are a number of reasons for why the above situations occur. The message of the exhibit may be more important than the actual display accuracy. For example, cleaning symbiosis may be the theme of an exhibit and the actual selection of fish is not important. Perhaps the exhibit is designed to illustrate a diversity of organisms and not a specific habitat? In some cases there is pressure to display animals that suddenly become available and they are added to whatever display can best house them. In many aquaria the education department has a species list that they follow in guided tours for school groups that requires you to have them on display at all times, so you have to find room for them somewhere. Some displays are not very exciting or successful and often the addition of another species will improve the exhibit or satisfy public demand. Another possible reason may be lack of knowledge on the part of the exhibit designers, fabricators, curators and/or aquarists. It may also be that the degree of exhibit accuracy that is

considered adequate may allow for such discrepancies. Exhibit design and maintenance is at the best of times a juggling act, between accuracy, institutional requirements, public demand and specimen availability.

What to Do?

Well this question really relates back to the first paragraph. How important is it that our exhibits accurately depict nature? At what point to do we decide the exhibit is accurate enough? Is it really that important to be so accurate? Of course there are exceptions, and not every exhibit depicts a certain habitat or geographic region. However, if we are to call ourselves educational institutions then in my mind we have an obligation to be as accurate as possible for those exhibits that require it, to do less would be a disservice to the people who visit our aquariums. True, the vast majority would not recognize many of the "inaccuracies" I have mentioned, but does that excuse the fact that what they are being shown is not accurate?

From what I have seen, the answers to these questions come from above. It is the directors and curators of our institutions that set the policies for exhibits and what is expected. So what are the policies of your institution towards exhibit accuracy? Are there even any? Should there be? I think these are the kinds of things we should be thinking about when we design new exhibits, redesign old ones or just maintain what we now have.

The key of course is education, not only of our visitors, but also of ourselves. Inform yourself about the habitats and organisms that you plan to exhibit by utilizing the many resources available such as magazines, scientific journals, the Internet, and identification and guidebooks. Of course the ideal would be to actually visit the locales you are trying to depict, but most aquarium budgets do not allow for this. That is where books, videos and other aquarists become valuable resources. Of course the bottom line is … is it all worth the effort? In my mind it is … what is your institution's policy?

1999 REGIONAL AQUATICS WORKSHOP (RAW)

The 13th annual RAW meeting will be held at Underwater World at the Mall of the Americas on May 13-15, 1999. While registration is free (as always), please contact Craig Atkins at (612) 853-0615, or Jeff Krenner at (612) 853-0619 to let them know you will be coming, so they can make arrangements for the icebreaker, paper sessions, etc. The mailing address for the aquarium is 120 E. Broadway, Bloomington, MN 55425.

The Regional Aquatics Workshop is independent of other organizations and serves as forum for the exchange of information on husbandry, exhibitry and life support for aquarium professionals. No formal organizational structure exists other than what is provided by the host institutions. Midyear meetings of the AZA aquatic Taxon Advisory Groups are expected to be held in conjunction with RAW in 1999, as they have been for the past several years.

UPDATE ON THE SOUTH CAROLINA AQUARIUM

Christopher Andrews, Ph.D., Executive Director

South Carolina Aquarium, 57 Hasell Street, Charleston, SC 29401

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As of October 9, 1998 construction on the South Carolina Aquarium is more than 60% complete. Staff and volunteer have already begun to assemble the vast collection of indigenous species who will soon make their home in the Aquarium. Additionally, the non-profit Aquarium has netted nearly two-thirds of its $15 million capital campaign goal, which is raising private funds to complete the world-class exhibits that will distinguish the Aquarium as one the finest in the world.

The South Carolina Aquarium will be a non-profit, self-supporting institution, designed to display, interpret and conserve South Carolina's unique aquatic environments. It will open with an Education Master Plan fully in place. That Master Plan was created with input from national consultants and 200 South Carolina educators. The Aquarium hosted a number of in-state educators during this past summer to complete details on the program and its statewide rollout.

The South Carolina Aquarium's exhibits and programs are designed to educate and encourage involvement, while providing a memorable visitor experience through mystery, magic and spectacle. Without a doubt, education is the link between awareness and action. The Aquarium's mission is to educate visitors on the many ways in which they can help protect our natural world.

Scheduled to open in about 18 months (early 2000), the 93,000 square foot facility has a footprint equivalent to two football fields. It will contain nearly one million gallons of fresh- and salt-water, and more than 60 exhibits and 500 species of animals and plants native to the region. In all, 10,000 animals and 5,000 plants will call the Aquarium home, including fish, sharks, jellyfish, turtles, alligators, venomous snakes and birds.

Work on the Aquarium's 8,000 square foot Animal Holding Facility has been completed, and the former bottling warehouse now supports numerous tanks, water filtration systems and apparatus necessary to support all manner of aquatic species. The Aquarium collection now includes nearly one dozen loggerhead turtles, fresh-water and marine fish, sharks and others.

Stunning Architecture and Economic Catalyst

The Aquarium building will be architecturally stunning - and unique. It will project 200 feet out over the Cooper River, a constant reminder of the relationship between the exhibits and the vibrant waters of the Harbor, where dolphins, otters and osprey may be seen. Construction of the Aquarium's Riverside Terrace is now complete.

Inside the Aquarium, the exhibits will present an intimate look at the natural habitats of

South Carolina that few have the opportunity to see.. Beginning in the Blue Ridge Mountains and extending coastward, these exhibits will feature high mountain waterfalls and rushing streams, swamps and rivers of the Piedmont, some of the most beautiful and unspoiled salt marshes remaining in the world and offshore waters teeming with a diverse range of exotic species.

The site chosen for the Aquarium was formerly an abandoned industrial zone. Following extensive studies and careful remediation efforts, this urban waterfront will now become a vital part of the City of Charleston. Construction has begun on a national park site adjacent to the Aquarium, and the city will add a new, 1,100 car-parking garage. Recent completion of the city's Maritime Center complements additional plans for nearby development.

More than one million people are expected to visit each year, and in its first five years of operation the Aquarium is projected to generate a statewide economic impact of $550 million. The Aquarium will also create more than 100 direct and 1,800 indirect jobs.

The Aquarium is presently recruiting volunteers from around the state, whose support will be key to the institution's success. The institution also expects to fill a range of professional positions within the next 18 months. Frequent updates and job postings can be found on the Aquarium's web site at http://www.scaquarium.org.

NEWS FROM THE ORANGE COAST COLLEGE PUBLIC AQUARIUM

Dennis L. Kelly, Aquarium Director

Orange Coast College Public Aquarium
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With the opening of the brand new Long Beach Aquarium of the Pacific on June 26 of this year, we have rededicated ourselves to offering the best training available for undergraduate marine science students in Aquarium Science and Technology. Our training program is now 10 years old and we have former aquarium students working at Rain Forest Café (caring for their aquarium systems at two sites), Cabrillo Marine Aquarium in San Pedro, and at the OSPER Lab of California Dept. of Fish and Game at Santa Cruz. We managed to get only one student into the Long Beach Aquarium of the Pacific as a volunteer - but we are not giving up!

Students here start with the Beginning Aquarium Class and learn all the basic techniques and water chemistry along with feeding, collecting, display-set up, equipment repair, disease treatment, isolation, names and characteristics of specific species, and cleaning. They earn one unit of credit and put in 36 hours outside of class working in either of our two large tropical aquariums or in our 1000+ gallon cold water system (stocked with local fish and invertebrates). In the course of their studies, reading, quizzes, exams, journal keeping, and outside of class work; they also take field trips to nearby aquariums, aquaculture businesses, and tropical

aquarium stores. From this group at least two students are selected to be Aquarium Managers the following semester. They earn two units of credit and learn how to manage others, schedule students, square away interpersonal problems, budget money, run fund-raisers,
manage records, and contribute to strategic planning for the aquarium along with the Aquarium Director. These are the people that are primarily being snapped up by other aquariums. Some have even started their own aquarium maintenance businesses. They have between 154 and 200 hours worth of training and hands-on experience and are pretty savvy when it comes to being creative with regards to running aquariums.

This school year (August 1998 to May 1999) we are adding a new 160 gallon "predator" tank aquarium - stingrays, small sharks, etc. - with a chiller to our system. We have a new tropical aquarium isolation tank we are setting up. Finally, we are finally getting around to designing and fabricating display/informational lighted boards above each of our temperate tanks. We have let this go far too long and it is high time we mimic the displays that exist at all major aquarium to inform the public of what they are looking at and a bit of its natural history (along with a color photograph). Finally, the plans for our new school library still contain the design of a 40,000 gallon temperate display tank. When this is built it will increase our capacity immensely.

We have, over the past year, caught juvenile Giant Black Sea Bass (Steriolepas gigas) during shallow water trawls off the coast of Orange County. Before we always released them immediately. The most recent acquisition late last year) we did not throw back but contacted California Department of Fish and Game. We asked for permission to keep these two babies and raise them in the aquarium. They granted permission and we were able to keep both of them alive for over ten months in captivity where they grew to 250% of their original size. One was accidentally released into Newport Bay by mistake by a student who thought he was doing the right thing (one of the inherent problems when dealing with undergraduates). The other, unfortunately, died just last week (we think the power at the school was turned off over the weekend and the water temperature change shocked the black sea bass). The students involved with the husbandry, for both of these representatives of an endangered species off our coast, really learned a lot and it was a terrific experience for them. I do not remember seeing Giant Black Sea Bass as a focused exhibit at any of the large aquarium along the California coast (please correct me if I'm wrong!). I know they are on display but I am thinking that since we catch the juveniles periodically, possibly we can create an interesting and educational display around them.

We are looking forward to a very exciting and challenging school year. The new beginning aquarium class meets for the first time on Friday, August 21. Wish us luck and drop by for a visit if you are in the area. Always glad to accommodate those who read Drum and Croaker!

ACUARIO NACIONAL OF THE DOMINICAN REPUBLIC

The Acuario Nacional of the Dominican Republic was inaugurated on November 8th, 1990, after approximately 2 years of construction and 5 years of planning. It is a non-profit government institution with an active Board of Trustees, and its primary goal is to increase the consciousness, public awareness, and education of the masses on the different aquatic environments, their inhabitants and their fragility.

It is located on the southern coast of the Dominican Republic, only meters from the Caribbean Sea, and at a 15-20 minute drive from Santo Domingo, the capital of the Dominican Republic. It's total area is approximately 25,000 square meters, but only 5,000 of these are constructed. The rest is recreational and/or for future expansion. In addition to an auditorium (seating 100), offices, laboratory, nutrition and quarantine areas, the Acuario Nacional has three main exhibit areas. The first is a large marine area housing 51 fish and invertebrate exhibits, plus two turtle tanks and a touch pool. All animals and plants in these exhibits are marine and from the Caribbean. The freshwater area consists of 26 exhibits of species from all over the world, including a special exhibit of Venezuelan fish. Finally, the third area consists of the larger tanks: a shark tank, a legitimate shipwreck exhibit of a Spanish galleon, a mangrove swamp, an iguana exhibit, and a coral reef exhibit. It averages 300,000 gallons of seawater, which is pumped directly from the ocean right next door. The tank is traversed by an acrylic tunnel which is quite impressive.

The Acuario Nacional is open six days a week including all holidays except New Years Day, from 9:30 AM to 6:00 PM. Guided tours are available upon request and previous reservation, although the aquarium was designed as a self-guided tour.

The Acuario Nacional maintains a close working relationship with other institutions with similar goals, both on a national and at an international level, such as the National Parks Service, the Center for Marine Biology Research of the University, local NGOs, the National Aquarium in Baltimore, the John G. Shedd Aquarium of Chicago, etc. In addition to the educational activities the Acuario Nacional is actively involved in, the aquarium also does much work in national marine protected areas, in terms of active research, monitoring, and management plan design.

Enrique Pugibet, Director
Monica Vega, Curator and Conservation Affairs
Acuario Nacional, Santo Domingo, Dominican Republic (809) 592-1509 Fax: 593-0029

WHITE SHARKS IN SCOTLAND - A CASE OF MISTAKEN IDENTITY?

Over the latter part of the Summer I received reports from various sources that a specimen of the Great White Shark, *Carcharodon carcharias*, had been sighted "rampaging through seal colonies" (sic "The Scotsman" newspaper 7th September 1998). This followed on from other reports of the same species which had allegedly been spotted earlier in the year.

The Great White Shark (*Carcharodon carcharias*, Linn, 1758, Order Lamniformes, Family Lamnidae) is considered to be primarily a coastal and offshore species with a coastal and amphitemperate geographical distribution (Compagno 1984). It preys upon a wide range of other species including bony fish, other elasmobranchs, marine mammals including cetaceans (probably as carrion) as well as invertebrates. Maximum total length is quoted as at least 640 cms and possible to over 800 cms, with a length-weight power curve, generated from 98 specimens, of: $WT = 4.34 \times 10^{-6} TL^{3.14}$ (Compagno 1984).

A vast amount of literature has been written concerning this species, mainly resulting from the aftermath of the "Jaws" phenomenon in the 1970's. Unfortunately for every one rational, well researched study there seems to be at least half a dozen articles extolling the apparent ferocity of this shark, and needless to say that as soon as the media get hold of any story concerning such a fish it generates a great deal of interest. Although the nearest authenticated sighting as far as the UK is concerned occurred off La Rochelle in France, there appears to be no reason *in theory* why the White Shark could not occur off the Scottish coast. They seem to prefer the same water temperature range as we get, and there are may seal colonies which could support such an animal. After the initial sighting at the start of the year the general consensus of opinion was that the animal sighted was probably a Porgbeagle, *Lamna nasus*, which was observed pursuing a shoal fish, and not as at first thought, seals, In all likelihood the Porbeagle was after the same food source as the seal, and not the seal itself. It has also been suggested that the more recent sighting was of a Basking Shark, *Cetorhinus maximus*, although I would suggest that skippers of boat crews who have reported these sightings are unlikely to confuse what is a relatively common, slow, benign and massive species with a fast, streamlined pelagic super-predator. Other marine biologists are skeptical and wish to adopt an open minded policy on these sightings. Personally I would love to add White Sharks to the 30 species which are known to occur off the UK, but I am convinced that if such an animal is ever genuinely recorded off our coasts it would open the flood gates for shark hunters hell-bent on adding the animal to their trophy list. It is perhaps best that the Scottish White Sharks adopt a "mystery policy" in line with their famous contemporary water dweller in Loch Ness.

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Compagno, L.J.V. 1984. Sharks of the World - An Annotated and Illustrate Catalogue of Shark Species Known to Date. Part 1 - Hexanchiformes to Lamniformes. FAO Species catalogue Vol. 4, Rome 249 pp.

Gordon S. Croft, Displays Curator - Elasmobranchs
St. Andrews Sea Life Centre, The Scores, St. Andrews, Fife, Scotland.

RARE FISHES ON DISPLAY AT CLEVELAND METROPARKS ZOO

The Cleveland Metroparks Zoo has recently acquired several specimens of *Pygocentrus (Serrasalmus) piraya*. We currently have a school of 20 specimens in a 1,000 gallon exhibit and another 16 on reserve in the Primate, Cat, and Aquatics building. If you are not familiar with this species, its is probably because they seem to be exceptionally rare to non-existent in captivity. This species is the original piranha species described by European explorers in the mid 1600's and is reported to be the largest species attaining a length of up to 24 inches. It is native to only the Rio Sao Francisco, a river system which is independent of the Amazon, in south eastern Brazil. If anyone is familiar with this species or knows of any institution or individuals who have, or have had this species, please contact us.

We have just received two Australian Lungfish *(Neoceratodus forsteri*) from the Vancouver Aquarium giving us a total of nine specimens. We think that this is the largest collection of this species outside of Australia. We are soon planning to ultrasound the animals for sex determination and to implant transponders for identification purposes.

Also new to the Cleveland Metroparks Zoo are Brook Trout *(Salvelinus fontinalis)*. We recently received 4.2 specimens which are most likely some of the last few relicts of the original native Ohio population. Ohio has been stocking brook trout in our streams for some time now, however they have been of the Quebec strain. In 1972 two glacial remnant populations were discovered in the very tiny headwaters of the Chagrin River system. Unfortunately, in 1993 one of the streams was destroyed by developing and the last remaining population is almost destined to the same fate. Currently they are being housed in a 300 gallon closed system but we are planning to move these, along with additional specimens, into a 3,000 gallon outdoor exhibit in our Wolf Wilderness exhibit. Our population is deemed to be a "safe haven" for preserving the DNA of this unique strain.

Nick Zarlinga
Cleveland Metroparks Zoo

NEW CLEANING TOOLS

Over 90% of various shapes and sizes of exhibit tanks at the Monterey Bay Aquarium are acrylic. Everyday maintenance is a must to give the visitors a clear view of the ocean inhabitants. One tool that has been an efficiency and energy saver is Black and Decker's "ScumBuster". A rechargeable battery operated rotary brush that can operate underwater. The tool comes with an interchangeable brush cleaning head and attachment that can hold various cleaning pads. For use on acrylic windows our favorite pad is one we make by double wrapping a 3M Scotch-Brite 8440 Doodlebug white cleansing pad in soft nylon mesh and sealing the mesh to the back with silicone seal. Tenacious algae are no match for the low torque spinning action combined with the mesh pad. In areas where more cleansing action is necessary we put sodium thiosulfate in the exhibit water to neutralize the bleach as a precaution and then put a little bleach directly on the pad. The slow spinning action

keeps the chemical in contact with the pad and in the area where the cleaning is needed. Need to clean fowling algae off rocks? Change the attachment to the brush and swirl those pesky problems away. In addition to cleaning gel coated panels, Kydex, turtle shells, other uses are only limited by your imagination.

Alan Young
Monterey Bay Aquarium

THE CONTROL OF A DINOFLAGELLATE BLOOM IN A REEF EXHIBIT

Dinoflagellate blooms are an unfortunate occurrence in a reef aquarium, and little had been determined with regard to cause or solution. This article is intended only to relate our experiences with blooms and our subsequent course of action, and not to lay claim to any miracle cure.

Dinoflagellates have defied biological classification for years, being designated as plants or animals depending on the reference. These organisms in situ bloom periodically as a result of shifts in nutrient composition, sunlight and other water quality parameters. It is therefore a fairly safe assumption that these parameters are also interconnected with the blooms in closed system aquariums. Most importantly, these blooms in aquarium systems often threaten the inhabitants of exhibits by their physical presence, and the production of neurotoxins.

At the Pittsburgh Zoo experienced a bloom in an 800 gallon reef tank late in the summer of 1997. The exhibit has six 6500 K, 400 watt metal halide bulbs and four, four foot actinics. The seawater is Reef Crystals with R.O/D.I. water with a RK2 protein skimmer. This exhibit had just recently been established and only a handful of corals (small polyp stony) had been added. Once the bloom began to take hold, inquiries as to an effective course of action to resolve this problem quickly ensued. Very little hard data was available, but many suggestions were discussed based on theory or speculation. Having searched for common denominators in the information gathered, we narrowed down our options to several systems parameters that we could easily manipulate in an effort to retard the bloom. Those options included pH, salinity, and photoperiod. It was decided to raise the pH by the additions of calcium hydroxide. Initially, we lowered the salinity from 36 to 29 ppt. and reduce the photoperiod from eight hours to four hours per day. This immediately resulted in a visible reduction in the dinoflagellate population, the mats would quickly return several hours after the lights were turned on. It was observed that associated with these dinoflagellate mats were areas of fine particulate matter that collected from the natural breakdown of the live rock (cured previously for 30 days). After four days of this protocol and the obvious lack of results, we resolved ourselves to the fact that additional action was necessary.

First, all the coral specimens were removed from the exhibit and quarantined. We then set up a 60 gpm standard diatomaceous earth filter (with 2 pounds of activated carbon added). Throughout the day the filter effluent was repositioned to physically disturb the entire system. We continued to maintain the salinity at 29 ppt. and a four hour per day photoperiod. We discontinued filtration after five straight days.

After the five days the filter was removed and the photoperiod was re-established to the

original eight hours per day. We anticipated a rapid return of the dinoflagellate mats, but to our surprise we did not see the problem re-occur. In the next week we gradually returned the original coral colonies to the exhibit. Even though we have since observed small mats growing in isolated locations, we have never witnessed the bloom as substantial as the original incident. As a general operating procedure for this exhibit every 8-10 months we repeat the filtration process explained in this paper without the manipulation of the water parameters and light.

Jim Prappas, Curator of Aquatic Life
Ken Billin, Aquarist
Pittsburgh Zoo

JELLY DIRECTORY

At the March 1998 American Zoo and Aquarium Association Western Regional Meeting in Monterey, CA, aquarists were invited to give presentations on sea jelly exhibits at their institutions. At this meeting it was agreed to start a directory of people working with jellies to promote sharing of information on collection, husbandry and display techniques. Anyone wishing to be included in this informal directory can submit the form below to Mike Schaadt at Cabrillo Marine Aquarium. Mike regularly re-compiles the list and sends out periodic updates to all those on the list. *(A registration form may be found on the following page.)*

Michael S. Schaadt, Exhibits Director
Cabrillo Marine Aquarium, Los Angeles, CA

JELLY DIRECTORY REGISRATION FORM

Institution: _____ Aquarist in charge: _____

Address: _____

City: _____ State: _____ Zip: _____

Phone: _____ FAX: _____ email: _____

Common and/or scientific name of jellies on display:

Common and/or scientific name of jellies cultured:

Type(s) of tank(s) used for display: (eg. planktonkreisel, cylinder, modified box)

Comments or Questions:

Please return to: Mike Schaadt, Cabrillo Marine Aquarium, 3720 Stephen White Dr., San Pedro, CA 90731 (310)548-7482 FAX (310)548-2649 (mschaadt@cerritos.edu)