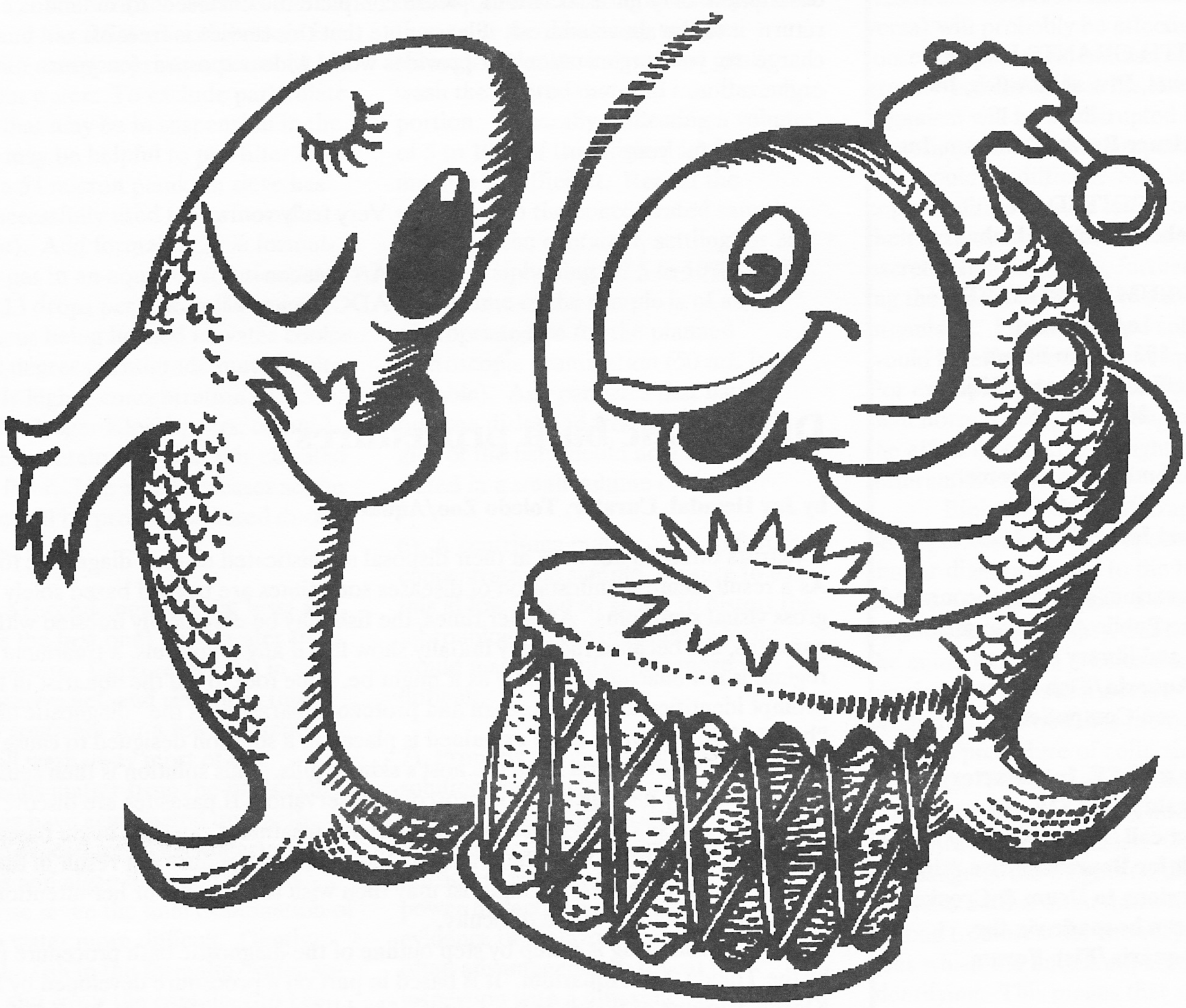
# DRUM & CROAKER



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# Aquatic Data Center

## Public Aquarium Directory
## 63 Green Meadow Boulevard
## Middletown, NJ 07748-3147

The Aquatic Data Center (ADC) is an exciting new addition to the Compuserve Information Service list of Forums, complementing the successful Aquaria/Fish Forum. Together they make up FISHNET. The ADC is planned as an extensive on-line database, dealing with many aspects of the aquarium hobby including freshwater and saltwater animal descriptions, business, products, book reviews, and a society directory.

As the coordinator of the Society Directory, I am anxious to include as many data files as possible describing the support organizations and membership programs available with your aquarium. If you wish to have a description of your associations, please complete the enclosed form and return it to the above address. Please note that this service is free of charge to your organization, yet provides world wide exposure for your organization.

Thank you for your input.

Very truly yours,

Art Deacon
ADC Society Librarian

# Diagnostic bath procedures

**by Jay Hemdal, Curator, Toledo Zoo/Aquarium**

Aquarists often do not have at their disposal sophisticated disease diagnostic tools. As a result, acute manifestation of diseases sometimes are treated based solely on gross visual symptoms. At other times, the fish may be chronically infested with parasites, but because they may initially show few if any symptoms, a treatment regime is not enacted as rapidly as it might be. One tool to aid the aquarist in the prompt identification of metazoan and protozoan parasites is the "diagnostic dip" or "bath". The specimen to be examined is placed in a solution designed to cause the parasites to be dislodged from the host's skin or gills. This solution is then settled to concentrate any pathogens for microscopic observation. If parasites are discovered during the course of this procedure, an effective treatment can then begin based on the proper identification of the problem. Should the procedure not result in the observation of parasites, the aquarist may then wish to focus his or her attention on other possible causes of the difficulty.

The following is a step by step outline of the diagnostic bath procedure used by the Toledo Zoo Aquarium. It is based in part on a procedure developed by Roger Klocek, Curator of Fishes at the John G. Shedd Aquarium, Chicago. Dr. Mark Lloyd (TZS) suggested the refinement shown in step three, of rinsing extraneous material from the fish prior to the procedure, as well as the use of a centrifuge outlined in step six. Other modifications to this technique were added by the TZS Aquarium staff.

1) The specimen must first be evaluated for the following characteristics:

a. Are there valid reasons for attempting this potentially stressful procedure? (Is the fish new to the facility, is it showing obvious disease symptoms, etc.)

b. Can the specimen be removed from the tank for evaluation with a minimal amount stress?

c. Does this species of fish have a known intolerance to formalin solutions? (Scaleless fish often do)

d. What is the minimum size container that will safely house the animal during the procedure?

2) Fill a container (one which is inert in water, and has a flat smooth bottom is best) with an appropriate amount of aquarium water. To exclude particulate matter that may be in suspension in the tank, it may be helpful to pre-filter this water (a 53 micron plankton sieve has been successfully used to perform this function). Add formalin (37% formaldehyde gas in an aqueous solution) at a rate of 13 drops per gallon (166 ppm). Specimens being housed in water cooler than 20 degrees centigrade may require a slightly higher concentration of formalin (Roger Klocek, pers. comm.). Place the container so that it is elevated off the floor. Use an air releaser so the solution will be properly aerated during the procedure.

3) Fill a second container (at least as large as the first one) with water from the aquarium. Capture the fish in a non-abrasive net, and rinse it in this second container for a few moments. This will wash away most of the extraneous matter from the fish's skin that may have acuminated during the capture procedure. This material, detritus and algae filaments, would otherwise make the final examination of the dip water more difficult. Gently place the fish in the formalin/water solution, and cover the container to keep the fish secure and calm. Begin timing the procedure now.

4) Observe the fish at five minute intervals for evidence of stress. Should any major indication of stress be noted (loss of equilibrium, improper breathing rate, etc.) the procedure may need to be terminated early. After one hour, return the fish to the aquarium, remove the airstone from the dip solution, and incline the container at a 20 to 35 degree angle from horizontal.

5) After the bath solution has settled for 30 minutes, siphon a portion of the water from the bottom of the container (especially the lowest point) into a smaller glass container. Some surface water may also need to be collected if there is any indication of fish mucus floating at the surface. An adjunct means of concentrating the sample is to then pour the remaining sample through a plankton sieve, and gently wash the filtered material into the subportion. Generally, collecting a volume of 5 to 10% of the original in this manner is sufficient. Repeat the process with the concentrated sample (inclining the container, settling for 30 minutes, siphoning off 5 to 10%) until the volume of the sample is of an appropriate size for the planned microscopic examination (50 mL is suitable). Any parasites that have become dislodged from the skin and gills of the fish should now be concentrated in a small volume of water.

6) A centrifuge may be used to further concentrate the sample. Be sure to use this at low speed so as not to distort the morphology of the parasites, which would make identification more difficult.

7) Properly dispose of all unused bath solution, and begin the microscopic examination promptly. Using the final concentrated solution, examine a portion of the sample under a low power dissecting microscope for evidence of metazoan parasites. It is often advantageous to repeat this inspection with a different sub-sample to insure that nothing is missed. Next, place a few drops of the sample under a compound microscope at 60 to 100 power and check for the presence of protozoans. If during the removal of these portions, the sample is agitated, time should be allotted to allow for resettling. Interpreting the results of a diagnostic bath requires some experience in that the parasites may have been changed morphologically by exposure to the formalin. Generally, the presence of any parasitic metazoan indicates the need for a treatment regime to be developed. Incidental non-parasitic protozoans may be present, and do not necessarily demonstrate the need for a treatment.

Formalin is perhaps not the only irritant which can be used to dislodge parasites during a diagnostic bath. Osmotic differential baths (exposure to freshwater of a marine fish, and vice versa) will probably be effective at loosening parasites, but there is a greater possibility that the shape of the organism will be so disrupted by osmotic pressure, that proper identification would be difficult. Solutions of copper sulfate appear to be too slow in their action, and might cause the fish to excrete copious mucus, further hampering the identification of the disease organisms. Perhaps mixed solutions would be effective for some species. For example, using formalin at a lower than normal dosage, but augmenting the effect by creating a slight osmotic differential as well.

Biopsies, or "skin scrapes" are often performed on live specimens as a similar diagnostic tool to the bath procedure. One can acquire a sample faster by performing a biopsy, but the stress to the animal may be greater due to the physical abrasion that occurs. A biopsy, promptly examined, has the benefit over the bath procedure of collecting live parasites. The motion of a living protozoan parasite makes microscopic identification much easier. One major advantage of the diagnostic dip is that a formalin bath is often times the prescribed treatment for the very pathogens which the bath is capable of identifying. This means that should a problem be discovered during the course of this procedure, the diagnostic bath itself will have had some therapeutic effect.

# The Aquarium Resource and stimulus for multidisciplinary interpretation in the work of the Norwegian Forestry Museum

by Coristian Andersen


SUMMARY

Based on the aquarium "Mountain lake to river estuary" the close connection between natural and cultural history within the field of the Norwegian Forestry Museum is elucidated, i.e. forestry, hunting and freshwater fishery, with special relevance to the latter. The hatchery "From egg to food resource" draws the lines to cultivation (strengthening of natural fish stocks) in lakes and rivers, and to commercial fish farming. In various ways one wishes to stimulate to studies and ecological understanding of nature, and to a better exploitation of the inland fish resource. A visit to the aquarium and the freshwater fishery department can be naturally enhanced by various field activities. The river Glomma which flows through the museum area and the museum's new field station (museum of timber floating) are very suitable for such activities.

RESUME

En partant de l'aquarium "Des lacs the montagne a l'estuaire" sont exposes les rapport tres proches entre l'histoire naturelle et l'histoire culturelle, au sein du champ de travail du musee forestier norvegien: la foret, la chasse et la peche en eau douce, en insistant tout particulierement sur ce dernier theme. La section "Des oeufs au poisson" montre les lignes communes entre la culture (renforcer les ressources naturelles de poissons) en lacs et rivieres, et l'elevage du poisson pour le commerce. De differentes facons, on cherche a stimuler le desi.r d'etudier et de comprendre l'ecologie de la nature, et d'inciter a une meilleure exploitation des ressources de poissons d'eau douce. Une visite a l'aquarium et a la section peche du musee est naturellement suivie d'activites sur le chantier. La riviere Glomma, qui coule a travers le domaine du musee et la section nouvelle du musee (musee du flottage du bois) sont, on ne peut mieux, appropriees a ces activites.


The Norwegian Forestry Museum was founded in 1954, and is the only Norwegian museum whose sphere of interests is the utilization of the wilds and the backwoods, i.e. forestry, hunting and fishing.

The museum is located in Elverum, in the very heart of Norwegian forest land, and in a district rich in hunting traditions; some 150 kms north of the capital Oslo. It lies on the bank of the River Glomma, for centuries a timber floating watercourse and a source of freshwater fish. The museum's field of interest ranges over the entire country, including the island of Spitsbergen. Approximately 100,000 people visit the museum annually. Among our visitors, 20,000 are pupils and students. The staff numbers 25 permanent employees including a research staff of 4. In addition here are several part-time employees. The aquarium exhibits have been arranged under the title "Mountain lake to river estuary". It was opened on June 22, 1979, and is the only Norwegian aquarium in which the main emphasis is placed on freshwater fish.

Basically the aquarium exhibits some 30 species of Norwegian freshwater fish in biotopes resembling their natural habitats. The 41 species found in Norway have all arrived within the last 9,000 years or so (i.e. since the end of the last glacial period, or ice age). Most arrived of their own accord, but some were deliberately imported. An information board on the way down to the aquarium informs the visitors on this subject.

## GENERAL INFORMATION

The aquarium obtains its fresh water from a well outside the museum building. Some 8,000 litres of water per hour are pumped up from a depth of 30 metres and run without filtration through a pressure regulating tank and straight into the main water pipes. It maintains a relatively constant temperature, varying in the course of the year between 6.5° C and 9.5° C. There is a constant flow through most of the individual aquaria.

The brackish-water and seawater aquaria, together with some of the smaller aquaria, are maintained as separate closed units, each with its own cooling plant. Water temperature varies between 10° C and 13° C. Lately smaller aquaria (3-500 litres) have been installed in the cultural history department for freshwater fish. Here there are no water pipes, therefore these aquaria are run as closed units based on Eheim® filter and cooling systems. under construction is an aquarium depicting a pond with water insects and other small animals included in the fishes' bill of fare.

The largest aquaria have a water capacity of 2,300 litres, the medium-sized ones hold 500 litres, whilst the smallest can take almost 200 litres. In the river aquarium there is an intake of approximately 25,000 litres of water an hour, most of which is recirculated. The water of the brackish-water and seawater aquaria is changed once a year. The brackish-water and seawater aquaria are kept clear by means of Photozone® treatment and protein skimmer. Photozone® is created by irradiating the air with short wave light from an ultra-violet lamp.

A few words about the individual aquaria (representing different fish biotopes):

**Mountain lake biotope providing only**

**meager nutrition.** Lakes of this kind are bluish in colour, and contain a plentiful supply of oxygen at all levels. Plant life in the fringe zone between land and water is usually sparse. The most common species of fish are trout and grayling.

**River biotope.** The water of Norwegian rivers is, for the most part, clean, clear and rich in oxygen. Among the species common to rivers, trout and grayling are exhibited here.

**Lowland lake biotope providing only meager nutrition.** Though this type of lowland lake has much in common with mountain lakes, the greater fertility and luxuriance of the surrounding land and vegetation necessarily influences the kind of nutrients found in the lake. Beside trout and grayling, the commoner species of fish include powan, burbot, vendace, pike, perch, and minnow. Shoal fish biotope Smelt and vendace are the species in this aquarium.

**Forest tarn biotope.** This type of habitat is prevalent in forest and marshland. A forest tarn is usually small and relatively deep. The water is poor in minerals, and is yellowish-brown in colour. The bottom layer receives little or no oxygen. Forest tarn water often has a high acidity, and is poor in both plant and animal life. Perch and pike are the dominant species of fish.

**Lowland lake biotopes rich in nutrients.** This type of lake is usually found in agricultural areas. It has a plentiful supply of oxygen in the upper layers of water. On the lake bottom, however, the decomposition of organic debris requires a great deal of oxygen, and this may result in a shortage of oxygen i.n the lower layers of water. Water colour may vary from green to yellow-brown, often resulting in little depth of visibility. Common species here are roach, bronze bream, rudd, ruffe, ide, pike, perch, silver bream, bleak, asp, chub, and zander. Those species which are exhibited have been divided between two aquaria, thereby avoiding the problems arising from competition between the species.

**Migratory fish biotope.** This biotope represents a river pool and contains anadromous and catadromous species, i.e. species that migrate between freshwater and saltwater. Atlantic salmon, sea trout, and arctic char are the anadromous and eel the catadromous species.

**Brackish water biotope.** Normally the water in this aquarium has a 25 o/oo salinity. It contains flounder, Atlantic salmon and sea trout.

**Saltwater biotope.** The salinity of the water is approximately 34 o/oo. This aquarium contains species commonly found in Norwegian inshore waters.

The smaller aquaria contain species of fish that have been deliberately imported into the country, including among others brook trout, brown bullhead, tench, and crucian carp.

The aquarium also offers a small hatchery with rainbow trout. Here the visiting public can follow development from egg to fully-grown fish. There is a special photographic exhibition in this connection under the title "From egg to food resource". Lines of communication are drawn to e.g. cultivation (strengthening of natural fish stocks) in rivers and lakes, and commercial fish farming of Atlantic salmon, rainbow trout, Arctic char and other species. Teaching and interpretation based on the aquarium exhibits is adapted to the needs of people living inland to gain insight into the form of aquaculture, especially in connection with freshwater species which takes place in coastal districts. Latterly commercial fish farming has grown explosively in Norway in later years, and has been chosen as one of the main develop ment areas by the authorities.

The fish species in the aquarium are collected from surrounding lakes and waterways, and some are presented to us from collaborating biological stations and hatcheries.

As fish food we use mussels (*Mytilus edulis*), euphausiids (krill) and mosquito larvae, - in the hatchery dry feed.

For a number of reasons - particularly educational - we strive always to have several fish of each individual species in stock, both in the public aquaria and in the quarantine department. Because of the teaching programs connected to the aquarium it is important that the species can be observed throughout the year. Working with Norwegian wild fish species we cannot supply the stock during the year by shopping in zoo stores, as the tropical fish aquarists may do. When during late autumn the ice forms on lakes and rivers we are prevented from collecting new species until late spring or early summer.

**THE AQUARIUM AS A TEACHING AID**

Teaching and the dissemination of information are among the foremost tasks of the Norwegian Forestry Museum. Consequently the planning, layout, and presentation of the various exhibitions have been undertaken with school parties in mind. Since the education service was inaugurated in 1973, we have established contact with a large number of teachers. Hundreds have made use of the teachers' in-service training program to find out what the museum can offer. Through the aquarium we try to focus not only on the species man has exploited for domestic and commercial purposes throughout the ages, but also on the importance of the environment and living conditions of the fish, for the benefit of future generations. This includes taking up questions like conservation, especially industrial waste and air pollution, resulting in acid rain which is affecting flora and fauna in a negative way. One aim of the museum is to elucidate knowledge on the relationship between natural environment and cultural development. This will heighten understanding of the social problems connected with environmental pollution, and might pressurize politicians into taking steps to avoid an environmental disaster which threatens man's existence on earth.

One should always bear in mind that visitors to the aquarium have various needs and requirements. This is important when considering how much information should be made available - in addition to what they see through the glass walls of the aquarium tanks. For school parties, in particular, it is often desirable to allow them to concentrate on one thing at a time, and to restrict the amount of direct information available. In our aquarium the public is given information on the following:

- specific name in Norwegian, Latin, Danish, Swedish, English, German and French
- species habitat (by way of colour transparencies)
- species distribution, generally in Europe, shown on distribution maps.

Identification is usually necessary, but should only be an opening to more information. The main purpose is to transfer knowledge, not to exhibit the subject. It is relevant andi mportant to emphasize biologically relevant features, e.g. a biotope with its content.

For educational purposes c. 50 quiz sheets have been worked out for school parties ranging from 6 - 16 years of age.

To increase the capacity of the aquarium, and to make efficient learning possible, we have suitable premises close by where pupils can complete written and practical assignments in connection with their visits. These consist of a seminar room and auditorium, also making it possible to supplement visits with lectures, and relevant film and video presentations.

In Elverum there exists a local aquarium society with whom we keep a certain amount of contact. Some of their meetings and activities are held at the museum. We would like to widen this contact to comprise various forms of "workshops", i.e. for building and running aquaria, field studies etc.

Visits can be implemented in another way. A visit which starts in the aquarium can quite naturally continue in the cultural history section where information about the history of freshwater fishing, the role played by fish in the subsistence economy, and various methods of preparing and serving fish is readily available. The integration of a number of related subject areas as described here is consistent wit.h those taught in the elementary school: local history, social studies, environmental studies, natural sciences. For secondary schools the aquarium offers even more imaginative possibilities. The reorganization of secondary education (from the age of 16+) in Norway enables secondary schools to offer a range of new optional studies. A number of these could have their starting point here. Some might appear to be rat.her academic or even abstract, but the very fact that one can avail oneself of living creatures in one's studies gives those studies a different perspective; clothes them with a reality which no text book, however well illustrated. can achieve. Just consider the Possibilities that exist for the study of movement, of colour change and camouflage, of courtship and mating, of the care and protection of the spawn, or the morphological character of the fish and their adaptation to light and dark, to vegetation, and to varying currents. Observations made in the aquarium will also constitute a good starting point for understanding the fish's internal structure and physiology. And so on!

As a service the aquarium offers smaller, special-interest groups the opportunity to go behind scenes. One can, of course, provide the same information and instruction by means of close circuit television. However, understanding, practical insight and a feeling of involvement are best achieved by allowing people to wander around among the various technical devices, seeing for themselves. Such a scheme has its undoubted disadvantages in offering a good deal more noise and disturbance than is strictly desirable. However, the practice can always be discontinued if it should prove to have a negative effect on research projects. In principle I believe that a department such as ours ought to be public-minded and that complicated and difficult research projects should be left to the purely research institutions.

Running an aquarium is interesting and challenging work, especially when it can be given a wider dimension. We are now working on a scheme by which specially interested groups will be able to follow up their visit with various field activities (excursions, field study courses, etc.).

The River Glomma with its situation along the museum area is ideally suited for studies of the flora and fauna of running water, and other parameters within this type of ecosystem. In this connection it is natural to mention our newly acquired center of timber floating, "Sorlistoa" at Lake Osen some 65 kms north of the museum. where a museum is being established.

This property was purchased because of the concentration here of the multifarious activities of timber-floating on Lake Osen and its river systems. The site also offers potential for a combined natural history and cultural history instruction. Lake Osen is well stocked with fish with rich traditions especially within trout, powan and vendace fisheries. Communication lines can thus be drawn between this field station and the aquarium and fishery department at the museum. Living accommodation necessary for field courses and other activities is being constructed. Relevant groups for these activities are school parties, hunting and fishing associations etc. Field courses in aquaculture will probably center on subjects like:

- the use of drift and floating nets, ground nets, seines and pots,
- investigation of lakes based on a) natural resources b) fishery biology,
- environmental studies (acid rain, pollution, hydro power regulation)
- processing of fish haul.

**CONCLUSION**

Museums are in fact important service institutions. In my opinion aquaria should be considered in exactly the same way, and should be organized so as to promote the exchange of information, ideas and opinions, and to stimulate public interest. This cannot be adequately achieved by allowing the aquarium visitor to walk round, passively observing objects, illustrations, displays and fish tanks. It requires more - imagination, initiative, a willingness to go out to people - which the Norwegian Forestry Museum is endeavoring to do.

Of interest in this connection are the results of a public survey which the museum made in 1983. Among other things, this survey showed that: - the museum's exhibitions and displays appeal to people in all social classes, - more than 85% of those interviewed had seen all the indoor sections. The most popular section of the museum was the hunting, trapping and animal section. A clear second, however, was the aquarium.

With imaginative thinking aquaria (and museums) can be turned into first class teaching institutions whilst at the same time providing a considerable public service.

**APPENDIX**

Freshwater fish found in Norwegian lakes and rivers (imp. indicates that the species was not originally native to the country, but was deliberately introduced by humans):

1. Perch (*Perca fluviatilis*)
2. Asp (*Aspius aspius*)
3. Brook lamprey (*Lampetra planeri*)
4. Brook trout (*Salvelinus fontinalis)* imp.
5. Bream (*Abramis brama*)
6. Lake trout (*Salvelinus namaycush*) imp.
7. Brown bullhead (*Ictalarus nebulosus*) imp.
8. Lampern (*Lampetra fluviatilis*)
9. Silver bream (*Blicca bjoerkna*)
10. Pike (*Esox lucius*)
11. Zander (*Stizostedion lucioperca*)
12. Dace (*Leuciscus leuciscus*)
13. Goldfish (*Carassius auratus*) imp.
14. Grayling (*Thymallus thymallus*)
15. Four-horn sculpin (*Myoxocephalus quadricornis*)
16. Bullhead (*Cottus gobio*)
17. Ruffe (*Acerina cernua*)
18. Carp (*Cyprinus carpio*) imp.
19. Crucian carp (*Carassius carassius*) imp.
20. Pacific salmon (*Oncorhynchus keta*)
21. Smelt (*Osmerus eperlanus*)
22. Vendace (*Coregonus albula*)
23. Burbot (*Lota lota*)
24. Atlantic salmon (*Salmo salar*)
25. Bleak (*Alburnus alburnus*)
26. Roach (*Rutilus rutilus*)
27. Pink salmon (*Oncorhynchus gor buscha*)
28. Rainbow trout (*Salmo gairdneri*) imp.
29. Arctic char (*Salvelinus alpinus*)
30. Powan (*Coregonus lavaretus*)
31. Chub (*Leuciscus cephalus*)
32. Alpine bullhead (*Cottus poecilopus*)
33. Three-spined stickleback (*Gasteros teus aculeatus*)
34. Nine-spined stickleback (*Pungitius pungitius*)
35. Tench (*Tinca tinca*)
36. Rudd (*Scardinius erythrophthalmus*)
37. Ide (*Leuciscus idus*)
38. Minnow (*Phoxinus phoxinus*)
39. Trout (*Salmo trutta*)
40. Twaite shad (rare!) (*Alosa fallax*)
41. Allis shad (rare!) (*Alosa alosa*)

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**AQUARIUM : AN EDUCATIONAL TOOL**

A round table, very usefully augmented by comments from the audience, treated the question of the role of education in aquariums.

We all were, I believe, in accord on the central point : in performing the mission of the public aquarium, education is an integral part. In accomplishing education, we saw five main questions:

1. What is the balance between recreation and education? The answer is simple : you need both. But up to now, frankly stated, education is lagging and needs more of our attention and resources. The example was given of France, where lack of government support for such education has put the burden on aquariums themselves. We must go forward!

2. Whom do you teach? No conclusion was reached. Some pointed out that it was more efficient and cost effective to teach teachers. Others desired a focus on the children themselves. Above all, we all agreed that the family is a vital target. By introducing the ethics of conservation into the home, we increase the chance that the world of water will survive man's abuse.

3. How do you evaluate the success of your educational program? It is very difficult, but also very important. Three specific evaluation tools are mentioned :

a) Scientific sampling of visitors, such as in quarterly exit surveys (sampling only yearly gives false results because of the different types of visitors in high and low seasons)

b) Observation of visitors' interaction in front of specific exhibits.

c) Intensive questioning of visitors to test the knowledge gained.

All this must be done by specialists. Additionally, it pays large dividends to make mock-ups of planned exhibits to see how sample test audiences react.

How do you handle the need to

communicate with visitors speaking different languages? In this regard, after substantial discussion, we arrived at the conclusion that it is necessary to include the Latin (scientific) name on identification labels. Above that, a vigorous editing of interpretive material will hopefully permit making tests short enough so they can be reproduced and displayed in several languages.

That do we teach - biology, ecology, behavior, conservation or what? Again, the answer is everything, realizing that in fact very little learning does take place in any case. The message must be different for different occasions, but clearly conservation is key. Also, use of field trips, hands-on artifacts and interactive exhibits is very useful.

**GENERAL CONCLUSION**

Education is an integral part of the role of an aquarium to pass any message on conservation, environment, pollution etc. to our visitors. One should anyway avoid submerging the visitor and not try to "over-educate" as this might lead to losing achievement of the primary goal which is the purpose itself of education.



# The Thinking Gallery: Developing Interactive Exhibits at the New England Aquarium

**by Richard Duggan, Curator, Exhibits and Graphics Design**

**NTRODUCTION**

In 1985 we renovated New England Aquarium's Freshwater Gallery as part of an institution wide five-year capital improvement plan. During this time our thoughts turned to the planning of the next area slated for development: the temperate marine gallery. We realized that our exhibits illustrated many important scientific themes but that they were not organized in a formal manner. The temperate gallery, the first gallery of permanent exhibits that the visitor entered, provided an excellent opportunity to develop a new gallery that would offer a conceptual introduction to the marine sciences. We wanted it to stimulate the visitor to explore the rest of our collections in a more informed manner.

As the year progressed, so too did the ideas. By late 1985, a project proposal was completed and submitted to the National Science Foundation (NSF) in search of funds. The project was titled "The Thinking Gallery: Development of an inquiry-driven gallery in a living museum". The gallery was expected to cost over $600,000 which included educational programs, publications, life support systems, tanks, habitats, lighting, and all associated exhibit hardware, software, and furniture. By mid 1986, we had the promise of nearly half that amount from NSF and the rest from other sources. The work began in earnest.

We started a series of off-campus brainstorming meetings to flesh out our plans. The central theme of the Thinking Gallery emerged: What is a fish? Exhibit development meetings occurred weekly. Individual and group trips were made to institutions to investigate the successes of other exhibits. Our observations led us to believe that we needed to foster creative and critical thinking through interesting, multilayered exhibitry. We also wanted to incorporate interactive exhibits into the area and build more sophisticated environments through which we could teach the interrelationship of the animals and their associated habitats. The tanks, text, and tactile elements had to be accessible to adults, children and the handicapped with a variety of activities for each age group. Redundancy was to be built in. Since several other exhibits were scheduled to be produced during the next two years, and a separate space for prototype testing was out of the question, we decided to experiment with some of the new ideas in upcoming exhibits before incorporating them into our final plans.

Other than staffed interpretive programs, the interactive exhibits in operation at the aquarium in 1985 were entirely dependent on either twisting a knob or pushing a button. We proceeded to experiment with the creation of video programs, electronic devices, computers, toys, and tactile elements as well as habitats that permitted viewing both above and below the waterline. Each of the exhibits we made while the Thinking Gallery was being developed incorporated educational, aquarial, and technical aspects that we needed to research. Before we included high tech interactive elements in the final plans for the new gallery, we needed to test their reliability, performance, and effectiveness.

An exhibit called Don't Blink Now was created which combined live animal and video in stations showing taped segments of interesting and rarely seen behaviors played on a monitor viewed through an aquarium containing that particular animal. Each of the eight stations ran a 1-2 minute long video with minimal amounts of text. One of the subjects was a hermit crab that exchanged an old shell for a new "shell" made of glass -- the video caught him in the act as well as giving us a detailed view of how he holds onto the shell with his abdomen. People delighted in seeing the animal in a glass shell and on video simultaneously. We found that the typical viewer spent an average of thirty two seconds at each tank -- half of what was expected. We also measured the reliability and cost of maintaining eight constantly running VCR's and monitors for a year.

**Stars of the Sea.** One of the features of this special temporary exhibit was an undersea set with huge soft-sculptured sea stars. The big stars were fantastic. Kids and adults immediately started playing on and exploring them. The sucker feet were made with baby bottle nipples and the stomach could be pulled out. The experience taught me that it is best to use soft sculptural teaching materials in guided activities -- they really took a beating on the floor. A television camera was focussed on the area and children could watch themselves playing on a monitor. Next to this monitor was a monitor running footage of starfish interacting with other creatures in their environment. A look-down tank featured large magnifying lenses on tethers with which to observe sea stars more closely. The look-down magnifiers promoted a lot of inter-visitor activity and were tremendously popular, but we had a lot of trouble keeping the magnifiers tethered and untangled. We could not have loose magnifying lenses on an open tank; continuous exposure to school groups of all ages poses a constant threat of damage, and all exhibits must be built to withstand potential vandalism.

**Electric Eel.** The console above the tank contains sequential lights that light in proportion to the amount of electricity that the eels produce ( just like the LED displays on many stereo sets). In the handrail, which was an early prototype, visitors can compare their electrical potential to an electric eel's. The interest in the exhibit was soon attested to by the amount of water damage the graphics were getting. Kids ran over from the tide pool with wet hands and slapped them on the brass electrode 'hands' to make the lamps light. We had not counted on this. Water or not, the two electronic circuits that operate the exhibit continue to run dependably. Each cost less than $2000.

**Salmon.** In the Salmon exhibit we developed a stream/waterfall, natural habitat with a diorama. The limiting factors of our building's architecture on the physical layout of the large windowed exhibit became even more painfully apparent.

**Acid Rain.** We produced a minute and a half long video about the effects of acid rain on Massachusetts' wildlife. It ran on a TV monitor placed between the N.E. Stream and N.E. Pond tanks. Two of these stations were planned for the Thinking Gallery. The experiment proved to us that the video couldn't compete with the tanks. Visitors rarely stopped to watch the full program. We tried other videos as well to no avail.

**Boston Harbor.** The Boston Harbor exhibit contained two high tech experiments that were of interest to us in developing the Thinking Gallery. They were also the most expensive and time consuming to produce, and probably wouldn't have happened without the support of the NSF grant and a generous equipment donation from Digital Equipment Corporation.

Our first use of computers involved the Boston Harbor Game. This wittily written program tests your knowledge about Boston harbor's pollution problems and solutions. It is a multiple choice test that gives you the correct answer if you guess wrongly, and keeps track of your score as you play. Each of the three stations consist of a Digital PRO380 CPU with touch screen color monitor. We hooked the stations to a VAX computer located in the Edgerton Research Lab, to allow tabulation of visitor responses to the poll. The first station that we put on the floor for testing lasted almost two hours before it was smashed! It looked like someone had taken a hammer to it.

We had originally approached the project with some measure of trepidation, but we were now filled with fear and loathing at the thought of losing another $700 screen. Another trip back to the drawing board. We sent the screens to be backfilled with epoxy of the same refractive index as the glass. The process seals the relatively thin touch screen to the cathode ray tube behind it, creating a thick, nearly unbreakable laminate. Ten weeks later the unit went back on the floor and was once again destroyed within 7 hours. This was turning into a nightmare, someone had scratched up the conductive surface of the screen with a knife! The answer was found in a 3 mil thick sheet of lexan placed over the screen which didn't interefere with the operation. The units have run relatively well since then, we only have to reboot them a couple of times a day! In the world of the ideal, the computers should run all day after being started in the morning. In the world of the real, computers have strange bugs and bizarre behaviors that may not be understood. They are also extremely vulnerable to heat, stray electrical or magnetic fields, and other interferences. To cool off the equipment we added 6 blowers- the thing sounded like a 747 at takeoff.

All of the computer hardware was donated, while we had to purchase software, maintenance, and support. Since no one on staff had the time to program the 380's, we had to hire an outside consultant from the Children's Museum to do it. The program cost us less than $5000 to develop. But service and support costs about another $15,000 per year. The second experiment that we performed in the Boston Harbor exhibit, which we started in 1986, was installed nearly a month ago (5 months after we finished the Thinking Gallery). The Harbor Sludge Model was developed by NEA in collaboration with the Civil Engineering Dept. and Visible Language Workshop at Mass. Institute of Technology. The basic premise of this interactive computer model of the flushing action of Boston Harbor and Mass. Bay was to show the visitor that the tides actually provided little flushing action in our harbor. No matter where you spewed the daily output of over 500 million gallons of sewage, there was no escaping it. The pollution wouldn't magically go away, and that is why Boston Harbor is in the state it's in today. The default mode of the program presents the visitor with the effluent situation as it now exists. Digitized blobs of untreated sewage flow from points at the mouth of the harbor, swaying back and forth across the screen and growing in numbers as the simulated tides rise and fall. The program then prompts the viewer to pick a different location to dump the sewage. What do they learn? No matter where you put, you can't win.

The program took years to develop. It involves actual data on harbor circulation, measured by scientists at MIT. Unfortunately, due to equipment considerations and the huge amount of data that has to be processed the model runs at about one-sixth the speed that we desire. In other words, what we want the visitor to experience in twenty seconds takes nearly two minutes and does not hold their attention. The Problem occurred because the first test model was developed on another system. The first model looked wonderful and ran quickly. We were very excited but when the program was loaded onto our equipment it ran very slowly. Numerous efforts were made to speed it up but the system couldn't handle it. It can still be an interesting experience for the patient visitor...if no overly eager child's hands are competing to play with it. We are now seeking a final resolution to this difficulty and, I'm sure will in the end produce an interactive that is fun, educational and durable. But it's been a long way to get there.

These experiments served as prototypes for the Thinking Gallery. Some were successful, some only to a limited degree. The trial and error approach eliminated the Telephant traps' that could have stopped our project later on and taught us many lessons about time and money management. Most importantly, the process served as a reality check on what we perceived we could do and what we were actually able to accomplish given the funds and space we had to work with.

The Thinking Gallery is composed of six bays each measuring 15' x 15'. The bays are divided by concrete columns and graphic panels. The service gallery is elevated 3' higher than the floor level of the visitors gallery. Space is tight and rigidly ordered by the architecture.We were only able to identify a total of 90 sq. ft. of additional floor space in the area for new exhibits, which came at the cost of two benches -- we packed it in. The originally proposed plan called for areas to explore water dynamics, behavior observation stations, a tactile railing with a carpeted step, all new graphics, and take home information cards. By the time the project was finished, water dynamics was replaced by hearing, anatomy, and computer video stations. After our experience with the acid rain video we dropped the behavior observation (Don't Blink Now) stations. The step was eliminated in the interest of accessibility for handicapped and adult visitors, and the take home cards evolved into a gamecard. The tactile handrail with embedded cast bronze elements gradually developed into a modular console which would allow us to try different things. We couldn't replace the graphic panels; they served as valuable barriers between the tanks preserving the intimacy of each bay and were too expensive to replace entirely. We decided not to put interactive elements in them due to traffic bottlenecks which would surely occur. The final plan called for eight areas, six of which are centered around live exhibits. They include: Blue Hole- habitat & behavior, Ancient fishes-evolution; Form & function- shape and coloration; Saltmarsh & mangrove swamp- coastal nurseries; Schooling- predation and defense; Extremes- extreme environments that fish inhabit; Hearing and making sound; Anatomy; and video games. Because our visitor path has no clear circuit around this gallery, we couldn't close the whole gallery for the renovation. Each area had to be scheduled so that no more than one or two exhibits would be down at a time. The first area we attacked was the sounds exhibit. We opened this subcomponent as part of another exhibit called Wired for Sound. It consists of three stations: Hearing Ranges, Sounds, and the Bone Phone.

Hearing Ranges compares the hearing ranges of several animals. We designed a visual hearing range grid that corresponded to the sound ranges that each of the animals perceive. As you turn the knob the lit portion of the grid changes in direct relation to the pitch produced by a frequency generator. Unfortunately, a dolphin hears a much greater range of sounds than man and the largest portion of the scale can't be heard at all.

Sounds compares the way five different animals make sound. The first version of this component was complex.This exhibit, in fact, was revised and revised and will once again be revised. Besides being a guessing game in which you tried to match the sound to the source, mechanical toys that made sounds in an analoguous way were there for visitors to play with. Most of the toys lasted but a few hours and had to be continually replaced. We got rid of them. The sounds were digitized and stored in a computer that mysteriously crashed every couple of hours as well. We spent hours and hours trying to figure it out. We tried every power supply isolation device, signal suppressor, and attenuator known to modern science and still couldn't get our $5,000 device to work. Finally, in the interest of having an exhibit that worked, we pulled the computer and put in five $40 tape decks. They work. When you press the button, you hear the sound and a light indicates the part of the anatomy that produces the sound. However, tapes do not hold up as well as computer memories and are work intensive. Buttons can be work intensive too, and we found out when an enterprising visitor superglued them down. Bone Phone was inspired by a Laurie Anderson sculpture in the Steadlich museum in Amsterdam. It is a loose analogy to a fish's lateral line. You place your elbows on each of the transducers and place your palms against your temples. While we cannot exactly recreate the experience a fish may have through its lateral line, we can experience bone conduction as a humorous simile-the reward is hearing the opening theme of *Jaws* played through your arms. Our observations conclude once again that most people don't read directions. Many visitors cannot figure out what to do and bypass it unless they see someone doing it.

The first Thinking Gallery habitat to be installed was the Blue Hole. This was basically a refurbishment with the addition of stalactites, stalagmites, corals and lighting. It is a dramatic opener to the exhibit. There is no handrail in front of this tank; it was dropped in the interest of having a large window that you could get close to. It is particularly impressive to children since they come face to face with a 300 lb. Queensland grouper (*Promicrops lanceolatus*). Then they notice the neon gobies (*Gobiosoma oceanops*) and green moray eel (*Gymnothorax funebris*). Why doesn't the grouper eat them? Are they all fish? Both the identification labels above the windows and the graphic panels on either side of the tank hold the answers and the questions.

Our graphic panels are 6' x 7' cases containing 4' square rear-lit transparencies. We produce b&w artwork with Windows, this is made into a full size negative which is laminated to a 1/16" plexiglass sheet. The transparencies are taped into the windows and colored films are applied to the the back of drawings and text. Over the years I've noticed many museum seminars on how to make cheap labels. These are far from cheap. Each panel costs between $2-3000 to make, although a large part of the expense is in photo permissions. The structure of the transparency format for this gallery was changed from that which we had previously been using. The panel consists of a sidebar, a larger area of detail information, and a kid's panel. The format, while simple, allows visual complexity. As you look down the length of the gallery you can read all of the titles. The sidebar starts with a question and an answer. If you read the sidebar, you will understand the concept we are trying to get across. If you care to go further, you can look at the accompanying photos and captions. Children may read the kid's panel which features drawings and minimal text. All the other text was targeted for seventh grade reading level and run through both Gunning's fog index and the Flesch index to make sure grammar, syntax, and word complexity met the readibility (if not comprehension) requirements. There were nearly forty editorial and approval steps for the text and photo development of each of the 11 panels. How did we keep it all together?

The exhibit development team meets every week without fail . Everyone involved in the project attends these meetings. It is during these times that we review exhibit progress, share information, and plan future projects. Sub-group meetings are also planned and staff assigned to the various task forces. A large amount of the group's energy is spent criticising ideas and designs. Our cumulative knowledge doesn't provide all the answers, however. Schedules need frequent alteration. No matter how well you plan, the "whoops!" factor must be reckoned with. It increases exponentially as you near an exhibit deadline and forces designers to respond quickly with new solutions to stubborn problems. While each of us has our responsibilities, we are all aware of how a slipped deadline in one area can effect an action in another area. As a consequence our group has developed into a flexible, responsive, and communicative entity. A lot of cross pollination takes place; aquarists suggest answers to design problems, educators make observations about collections, and designers may get involved in content development. We share our thoughts and build ideas as a team until we are satisfied that the whole of the collective idea is greater than the sum of its parts.

Back to the exhibits. Ancient Fishes is the next bay you enter. Flanking the central tank which contains ancient fishes (white sturgeon (*Acipenser transmontanus*), South American lungfish (*Lepidosiren paradoxa*) and longnose gars (*Lepisosteus osseus*)) are tanks containing modern teleosts and amphibians. Included in the central tank is a mechanized model coelacanth. It is a visual 'hook'. When you first notice it, it is hard to tell that it is fake- the unit moves more than the lungfish! It was actually cast from a dead specimen in California. Hopefully, the viewer will make an inquiry into why we have a model in the tank which may further lead to the consideration of issues about species conservation. (I might add that aquarists don't like latex fish in their tanks.) The handrail ties the evolutionary theme together. Cast into the 12' long rail are numerous fiberglass fossil replicas of fish and amphibians. The fiberglass has an agent added to it that makes it friendlier to the touch. The rail is visually and tactilely rich- a huge non verbal label intended to stimulate the visitor to think about how long the fishes have been on this planet and how they have evolved. It also stimulates inter-activities between visitors, as do all the rails. This fossils cost about $1200 to produce from originals at the Museum of Compara-

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**The following letter was received from a reader of *Drum & Croaker* in response to an article in the last issue.**

My heartiest congratulations to Frakes, Thomas A., 1989. "Suggested Research Protocol, etc." *Drum and Croaker* 22(3), 11-12. At last, a paper appropriate to the high purpose and traditions laid down by the founding father of this most prestigious scientific journal. I further rejoice in a paper that will be of interest to aquarists young and old, everywhere.

Farfal Knarby
Marine Extension Service
University of Georgia

tive Zoology, Harvard University.

Form and Function is explored in bay 3. The Shapes tank holds a surreal art habitat of abstracted representations of fish shapes which contains all the nooks, crannies and different spaces that each animal needs. The forms were cut out of single sheets of Sintra (an expanded pvc plastic product) and bent with a hot-wire and heat gun. The accompanying railing has models of shapes and fish forms to compare. The Race of Shapes also challenges the visitor, if he or she reads the instructions, to observe which shape moves fastest through the water. Our 'Colors at Depth' exhibit is viewer activated to slowly dim the tank lighting as depth indicators denote what the perceived depth is. Colors fade as the red spectrum diminishes during the 'dive'. In the handrail, images of fish are laminated to plexiglass panels which slide over differing backgrounds. The concept of camouflage is graphically revealed through this low tech device. It is a simple and effective approach. After our previous experiences, we thought the electronic device for dimming the lights would be a piece of cake. Wrong! It never worked properly, we weren't able to get the builder to come in and repair it, and it had to be returned. We are now working on the development of an opto-mechanical device that will accomplish the same goal...and we'll build it ourselves. While I'm at it, I'll add that the original price was supposed to be $2000. By the time the device was ready the creator was demanding $4000. Electronic devices can be very costly and I advise you to thoroughly consider what you want the equipment to do and write carefully worded documents when you contract for apparatus and installation.

The Saltmarsh and Mangrove Swamps occupies bay 4. These habitats were developed to give a closer look at the smaller life forms in our coastal nurseries. All of our habitats are produced in-house. We have a well ventilated studio which is equipped for fiberglassing, moldmaking, and general carpentry. While it is an expensive undertaking, it costs us nearly half as much to run a studio as it costs to use outside contractors for the work. The fishes department works very closely with us in the design, construction, and installation of the habitats to ensure that animals' needs are properly met. The Schooling exhibit fills bay 5 with a dazzling parade of blueback herring Alosa aestivalis against a stark black background. Flanking the tank are four color monitors which broadcast quick clips of another species' group behaviors. Commuters rush through the underground, traffic moves in relation to subtle cues, and synchronized swimmers burst across the screens. (As one visitor summed it up: "Look! Fish are just as stupid as people!") The handrail once again reinforces the notion of group behavior with a tactile school of small fish which are dispersed around a larger, vicious looking predator. Inside the tank a plastic predator lurks in the shadows. At scheduled intervals he is supposed to prowl the tank, but predator works too well. As originally conceived, he was to swim the tank and the school would break around him. As it worked out, the menhaden went into a frenzy on the first test, and fatalities resulted. Predator has since been put on hold until we are able to get a school of healthier herring. Across from the schooling tank there is an Anatomy station and two video stations. The anatomy puzzle offers activity to both young and old alike. It is very popular and always in use- as attested to by the wear it has received in 6 months. Puzzles should not be made with particle or flakeboard -- the materials are too brittle. It is worthwhile to use a high quality hard faced plywood like Baltic birch. The puzzle comes apart to reveal the internal anatomy of a typical teleost. Below it in a drawer is a soft sculpted 3-D fish that can be further investigated with the aid of an interpreter. The entire unit cost less than $6,000 with the lions share of the cost being cabinetry.

The Interactive computer stations are nestled to either side of the anatomy station. Each station consists of a Macintosh II CPU with 40Mb internal hard drive and an additional 4Mb of memory. A Sony Laserdisc player, 27" NEC color monitor, and 20" Intecolor monitor outfitted with a Microsoft touch screen complete the hardware aspects of the system. Driving this equipment is custom designed programming written in Hypercard which utilizes Videoworks and Pixelpaint software for the computer imagery. We must be on the cutting edge of technology by now! While the equipment may be ultracomplex, station operation is surprisingly friendly.The touch screen displays text and animated graphic prompts. The large screen plays the corresponding tracks from the laserdisc.

Any one of three games may be played: Is it a Fish?, What is it Doing?, or Wildlife in Danger. In Is it a Fish?, you are asked to decide whether or not an aquatic animal is a fish based on visual and verbal clues. You may see the clues as many times as you wish and answer as many times as you want, without penalization, until you find the answer. What is it Doing? is very similar to Is it a Fish? but stresses animal behavior, and Wildlife in Danger allows you to see and read about the endangered flora and fauna of Massachusetts. The exhibit makes use of some phenomenal underwater footage of rarely seen and unusual behaviors obtained from a disc produced in Japan. We also used 83 footage from Nova/WGBH and Peace River Films as well as slides from the Natural Heritage Program. All the programs are level III interactive Hypercard programs which allow visitors to browse through "stacks" of information as they please. The user sets the level and the pace. One subject runs intuitively into another. The system works very well yet we still find the occasional bug and are dependent on programming consultants to work out the problems. The Aquarium's design department is now working with the system so that we may be able to develop and debug our own programs in the future. The stations can each handle one participant at a time. Herein lies the drawback: Our institution draws about 1.3 million visitors per year, and that averages out to about 8.6

seconds that each visitor can have at the station. It takes a lot of time, money, and energy to create an educational program, gather video and film footage, procure usage rights, buy hardware, develop software programs, design and built exhibit stations, debug systems and then maintain them all. The development costs for a project of this calibre are outside the realm of possibility for most institutions. It cost us over $45,000 in direct costs including hardware (not including staff time which runs in the thousands) to develop the first station. If we had totally farmed the job out to a video house it would have cost two to three times as much. Each additional station costs only about $12,000. It is obvious that additional stations would make the project more cost effective in terms of public accessibility. Those costs are an excellent reason for developing collaborative ventures between like-minded institutions; which we plan to pursue in the future. Every potential producer should beware the 'soft' costs of disc production, ours were much higher than anticipated. Studio time is measured in hundreds of dollars per hour and cost overruns may easily occur in the production of an excellent product with even the most scrupulous budget management. And we know that we are being held to high production standards since the public's sophisticated video expectations have been bred by fifty years of TV broadcasting.

'Extremes' is the theme of the two tanks in the last bay. The fauna of Deep, Dark, and Cold benthic environments are contrasted with the wildlife of the desert. Giant sea roaches *Bathynomus giganteus* scavenge the ocean floor while spotted ratfish *Hydrolagus colliei* cruise the mysterious depths of this 500 gallon aquarium. The handrail has low relief models of gulpers, anglerfish, etc. attached to it. It is made entirely of aluminum, chosen for its conductivity, and is refrigerated with water from the tank. It feels very cold even without the refrigerant moving through it. By pressing the fish in the center of the console, you are invited to compare how much pressure you can exert on the model to how much pressure the animal's natural environment exerts on it. Some people like to pound on it... but they get the idea anyway because the scale rarely reads over about 60 lbs/sq.in. Compare that to 17,000!

Our last exhibit, the Desert tank, has unexpectedly become our showstopper. The handrail is hot and sandy, and contains a small tank of brine shrimp (*Artemia salina*) swimming under a fixed magnifying lens. The habitat is vast, bright and hot with lizards scampering over the gravel and rocks. The cross section of a spring reveals the activities of endangered desert pupfish (*Cyprinodon macularius*) with a few iridescent males defending territories. What really keeps the visitor's attention however, is the lizard activities. We didn't count on designing a "where's the lizard" game. When we started developing this tank three years ago, we had a hard time getting a handle on it. Three of us who were primarily responsible for the habitat design made a trip to the Sonoran Desert. We photographed the area, researched the flora and fauna, and made rock molds in 110 degree heat. The field trip proved to be a wonderful success. We got photos for the graphic panel and diorama references; gained first hand knowledge of the animals, their needs, and the environment; and made new molds of volcanic rocks which we will use for a variety of projects. Best of all, we replicated a larger ecological system and brought together a number of interacting species that many people, without experiencing in nature first-hand, will never-the-less appreciate and learn about.

That is the story of the Thinking Gallery and of the multi-leveled approach taken toward its creation. We know that what may look like play to an adult is learning for a child and that multiple types of intelligence must be appealed to. What is simple should stay simple but complexity must be possible. Consequently, the exhibits foster inter-activities which are interesting, accessible, and satisfying for the adult and the child in all of us. They keep us moving, touching and exploring. Whether we've been able to inspire awe about the aquasphere that surrounds us is yet to be tested, but we know that the hands on approach has enhanced learning, reasoning and cooperative skills for both visitors and staff. It is a small model for our aquariums of the future and for museum exhibitry in general.

# The Second Marine Aquarium Conference of North America

**Saturday and Sunday**
**April 21 and 22, 1990**
**Aurora, Ohio**

**Featuring Keynote Speakers:**
**Neville Coleman, Julian Sprung, Forrest Young,**
**George Blasiola, Tom Frakes, Don Johnson, Frank Murru**

The Second Marine Aquarium Conference of North America will be held on Saturday and Sunday, April 21 and 22 of 1990 in Aurora, Ohio. The Cleveland Saltwater Enthusiasts Association will be hosting the lectures. Tickets are limited for this exciting event, so please order yours soon.

Ticket prices for this conference are $65.00 (U.S.), and this includes admission to both days of the conference at the Aurora Woodlands Inn, a Best Western Hotel, and a ticket to the banquet on Saturday evening. Banquet tickets can be purchased separately at a cost of $25.00 (U.S.). The banquet is at Sea World of Ohio just minutes from Aurora Woodlands Inn. Although Sea World will be closed for the season, the aquarium building and Platters Restaurant will open for this event!

Hotel accommodations for visiting guests must be arranged by the individual parties, however, blocks of rooms have been reserved at the Inn where the conference will be held for a cost savings to you. **For hotel reservations call: 562-9151. For more information write to: Kent Seward, 26602 Osborne Road, Columbia Station, Ohio 44028.**

## CONFERENCE AGENDA

Registration and all lectures held at The Aurora Woodlands Inn, Aurora, Ohio.

**Saturday, April 21, 1990**

| | |
|---|---|
| 10:00 a.m. | Registration Opens |
| 10:45 to 4:45 | Lectures |
| 6:00 to 7:00 | Cocktails at The World of the Sea Aquarium Bldg. at Sea World. |
| 7:00 | Dinner at Platters Restaurant at Sea World. |

**Sunday, April 22, 1990**

| | |
|---|---|
| 9:45 a.m. | Conference Opens |
| 10:00 to 3:45 | Lectures |
| 4:00 to 4:30 | Giant Raffle |
| 4:30 to 5:30 | Panel Discussion |
| 5:45 | Conference Close |

## INTRODUCING THE SPEAKERS

**Neville Coleman** - is Australia's foremost underwater photographer and marine naturalist. Author of some 34 books, he has logged over 10,000 dives and discovered over 400 species new to science. He will present a program entitled "The Sea Life of the South Pacific."

**Julian Sprung** - holds a Bachelor of Science degree in Zoology from the University of Florida. He is the author of the monthly column "Reef Notes" in *Freshwater and Marine Aquarium* He will lecture on the care of marine organisms in a natural ecosystem, maintaining the important physical parameters.

**Forrest Young** - is the director of Dynasty Marine Associates in Marathon, Florida. He has been involved in the commercial rearing of tropical marine species such as clownfishes, basslets, and angelfish, among others. In addition, he has been collecting fish and invertebrates for 18 years.

**George Blasiola** - is the director of research and development at the Wardley Corporation. He will give a review of common fish diseases and will discuss nutrition and it's role in fish disease.

**Tom Frakes** - is the editor of *SeaScope,* the newsletter published by Aquarium Systems in Mentor, Ohio. He has extensive experience with marine aquaria and is an expert on water quality.

**Don Johnson** - is the editor of *Today's Aquarist Newsletter.* He has about 30 years experience with aquariums. His talk is entitled "Beneath the Reef", a study of the natural history and habits of the fish and invertebrates of the world.

**Frank Murru** - has been with Sea World for eighteen years. He is Vice President/General Curator of Sea World in Orlando, Florida. He will give us a look at the workings of Sea World and public aquariums in general; covering such topics as quarantine procedures, maintenance of "small" aquarium species, etc.

Also, a **POSTER SESSION** wherein persons attending the conference can exhibit some of their photos of marine life, charts or graphs illustrating experiments or projects , art work, etc.

And ... A **GIANT RAFFLE** of aquarium products!

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**YES! I want to attend the Second Marine Aquarium Conference of North America, and be a part of the new and exciting changes that are happening in the marine aquarium field today.**

_____ Number _______ Amount Conference and Banquet ($65.00 U.S.) / Banquet Only ($25.00 U.S.)
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Mail To: Kent Seward, 26602 Osborne Road, Columbia Station, Ohio 44028.

**AQUATIC DATA CENTER**

**PUBLIC AQUARIUM PROFILE**

**Please provide input on the following questions. Use extra sheets of paper as necessary.**

I. Public Aquarium Name and Address:

Name: ______________________________

Address: ______________________________

City, State, Zip: ______________________________

II. Support Organization Name and Address:

Name: ______________________________

Address: ______________________________

City, State, Zip: ______________________________

III. Charter of the Support Group: ______________________________

______________________________

IV. Membership Classes (Types) and associated Dues:

______________________________

______________________________

______________________________

______________________________

______________________________

V. Is the Support Organization Non-Profit? _______ If so, are membership dues and donations tax-deductible? _______

VI. Current Officers:

President/Chairperson: ______________________________

Membership Secretary: ______________________________

Treasurer: ______________________________

Others (Title and Name): ______________________________

______________________________

VII. Publication Name, Editor, and Reprint Policy: ____________

________________________________________________________________

________________________________________________________________

VIII. Meeting time(s) and Place: ________________________________

________________________________________________________________

________________________________________________________________

IX. Details of any special membership programs, such as trips, diving expeditions, behind the scenes tours, etc.

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X. Any other info you wish to provide: __________________________

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**NOTE:** This form may be photocopied and passed along to a colleague.

Mail the completed form to:

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