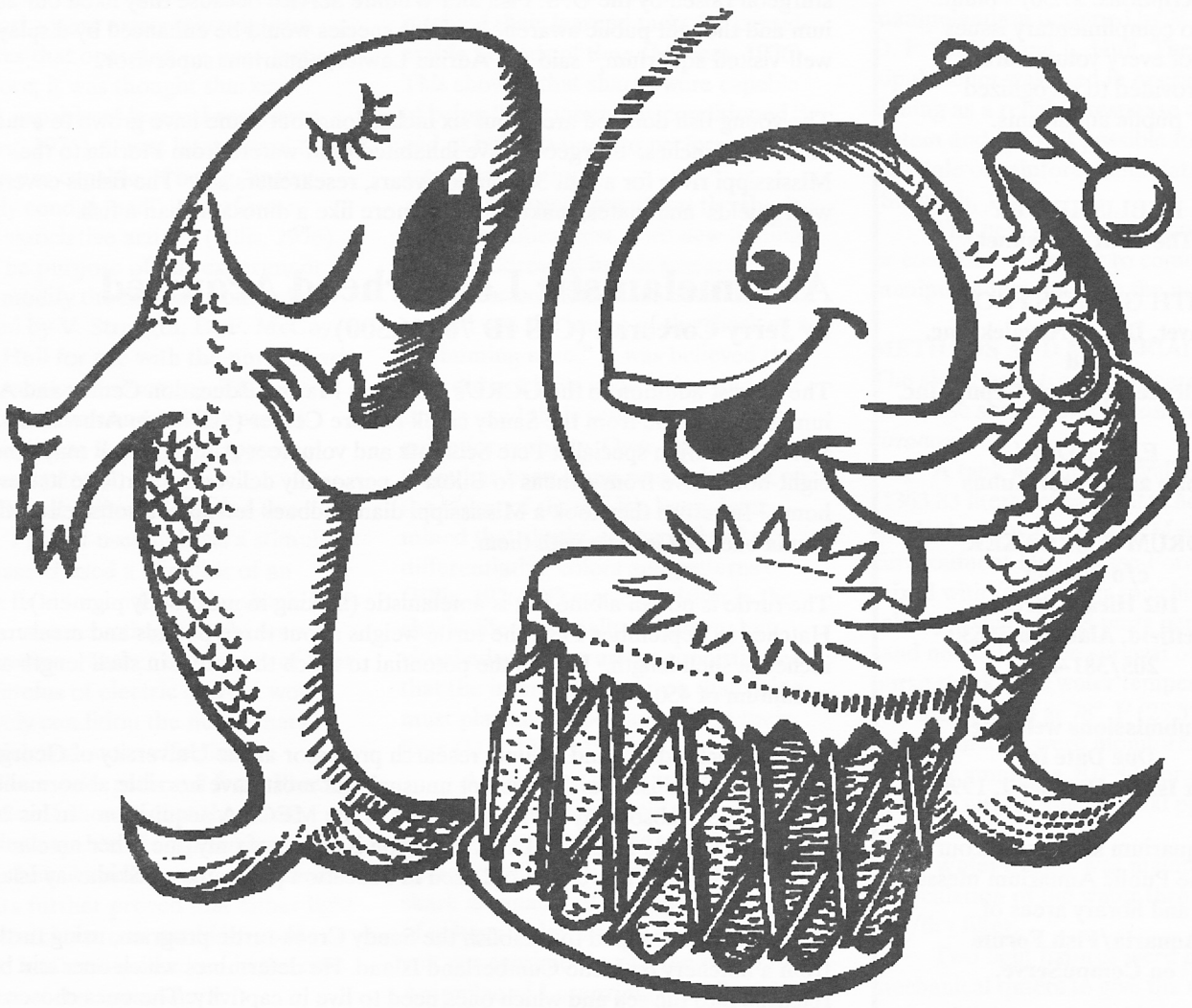
DRUM & CROAKER



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Aquarium Nets Sturgeon

(From Sun Herald, Biloxi,MS July 29,1990.)

The J. L. Scott Marine Education Center and Aquarium--just call it "the aquarium at Point Cadet"--has landed a coup. The facility now boasts a new exhibit Gulf of Mexico sturgeon, a prehistoric fish that is an endangered species in Mississippi.

"Our aquarium was chosen as the first facility to display the laboratory-reared Gulf sturgeon raised by the U. S. Fish and Wildlife Service because they liked our aquarium and thought public awareness of this species would be enhanced by display in a well-visited aquarium," said Dr. Adrian Lawler, aquarium supervisor.

The young fish donated are about six inches long, but some have grown to a maximum of 14 inches. Sturgeons have inhabited Gulf waters from Florida to the Mississippi river for about 300 million years, researchers say. The fish is covered with shields and plates, making it look more like a dinosaur than a fish.

An Amelanistic Loggerhead Acquired

by Jerry Corcoran (CIS ID 76066,500)

The newest addition to the GCRL's J.L. Scott Marine Education Center and Aquarium is a sea turtle from the Sandy creek Nature Center (SCNC) in Athens, Ga. SCNC education specialist Pete Schrantz and volunteer Annelle Beall made the eight-hour drive from Athens to Biloxi to personally deliver the turtle to its new home. In return they took a Mississippi diamondback terrapin, a softshell turtle and tilapia back to Georgia with them.

The turtle is not an albino but is amelanistic (lacking in most body pigment). Hatched in September 1989, the turtle weighs about three pounds and measures nine inches in shell length. He has the potential to reach three feet in shell length and a maximum of 450 pounds.

Dr. Jim Richardson, and adjunct research professor at the University of Georgia, said that amelanistic turtles are not unusual, but most have horrible abnormalities. "This turtle is absolutely perfect," he said of the MEC&A acquisition. In his 26 years of sea turtle research, Dr. Richardson is aware of only one other amelanistic loggerhead-Pinky, a five year-old used in education programs on Skidaway Island.

Dr. Richardson helped to establish the Sandy Creek turtle program, using turtles from a hatchery on Little Cumberland Island. He determines which ones can be released into the sea and which ones need to live in captivity. The ones chosen for captivity keep aquarium owners from catching healthy turtles for their exhibits.

Since Schrantz visited the MEC&A several years ago he and Dr. Lawler, MEC&A aquarium supervisor, have worked with SCNC director Mike Wharton to obtain one of the lab-reared turtles to replace another loggerhead and a Kemp's Ridley turtle which will be released in the near future.

"This turtle form Sandy Creek is priceless to us, as federal permits no longer allow us to keep the two turtles we now have or allow acquisition of any others unless they are abnormal and could not survive in the wild," Dr. Lawler explained. "The donated turtle was lab-reared due to injury in being at the bottom of the nest," he continued. "Since it is amelanistic, it would present an easy target for predators, so it can be permitted for display because of its doubtful survivability in the wild."

Development of the bite manuipulandum for use in the conditioning of the nurse shark (*Ginglymostoma cirratum*)

A behavioral paper presented to Naval National Science Awards Competition

by Lisa Michelle Pearman, Salisbury, Missouri 65281

ABSTRACT

In the 1960's it was a common belief that sharks were extremely primitive creatures that operated on pure instinct. Therefore, it was thought sharks weren't capable of learned responses (Myberg, 1976). It was later found that sharks were capable of being "instrumentally conditioned" to perform simple associative actions (Ellis, 1976).

The purpose of this experiment was to modify the bite manipulandum designed by V. Strength, D. F. McCoy and L. Hull for use with the nurse shark (*Ginglymostoma cirratum*). The bite manipulandum was used in operant conditioning as a reliable response detection system.

The experiment included two phases. Phase I used light as a stimulus and Phase II used a stimulus of an electric field to condition the shark. The purpose of conducting two phases was to determine whether a stimulus of light or a stimulus of electric current would effectively condition the nurse shark and which was more effective.

The results gathered from Phase I and Phase II showed that the nurse shark was capable of responding to the device when a stimulus was presented. The data further proved that either light or an electric current could be used with the bite manipulandum in the conditioning of the nurse shark.

INTRODUCTION

Over the past decades there has been very little research done on the behavior of sharks held in captivity. In the 1960's, there was a belief that sharks were inferior to bony fish and higher vertebrates in the extent to which their behavior could be modified through the learning process. Recent work has shown that young nurse sharks and lemon sharks could be trained as easily as many mammals. These sharks retained their learned tasks for considerable periods of time (Myberg, 1976). This showed that sharks were capable of being "instrumentally conditioned," and of being trained to perform simple associative actions.

Misconceptions about the shark and its abilities exist. Two new findings will be addressed in this research.

One belief that has been disproved was the image of the shark as a "swimming nose." It was believed that they did not have good vision and that sharks used their sense of smell as a guide for mobility. Over the past years there has been some research done on the vision of sharks. It's been determined that sharks are capable of differentiating colors and patterns (Ellis, 1976). The role of vision in the sharks life is virtually unknown, but visual adaptations are so sophisticated that the impression is given that vision must play and important role in their lives (U.S. Navy, 1975).

A discovery made in 1971 found that sharks can find their prey and orient themselves in the open sea by the detection of electric fields. The nurse shark is capable of responding to field of voltage as low as 100 millionths of a volt per centimeter with the use of their Ampullae of Lorenzini (Kalmijn, 1978).

This paper will deal with the development of the modified bite manipulandum for use with the nurse shark. The research had several purposes. The first was to prove that the modified bite manipulandum will give reliable response data and to determine whether a stimulus of light or a stimulus of electric current produces the best response. The second purpose was to show that the nurse shark is capable of being instrumentally conditioned.

The first step of the research involved the modification of the bite manipulandum designed by V. Strength, D. F. McCoy and L. Hull. The bite manipulandum was used in operant conditioning as a reliable response detection system and made it possible to obtain schedule of reinforcement data (Strength, 1981).

The next step was to actually train or condition the shark to come to the manipulandum and bite the nipple.

METHODS AND MATERIALS

The shark used for this research was the nurse shark (*Ginglymostoma cirratum*).

A tank holding 300 gallons (1363.83 liters) of salt water housed the shark. A salt water mix of Marine Environment Dual Phase Formula was mixed with fresh water to achieve a salinity level of 24-28 parts per thousand needed for the survival of the nurse shark. The water temperature was maintained at 78° F (25.5° C). Water parameters were monitored at 0.6 ppm for ammonia, 8.0-8.5 for pH, 0.75 ppm for nitrite, and 100-200 ppm for nitrate.

Water quality was maintained by recirculation of the water through a wet/dry filter.

Two light fixtures were placed on mechanical timers to give the shark 12 hours of light per day with now allowance for seasonal changes.

The bite manipulandum designed by Vernon Strength, D. F. McCoy, and Larry Hull was modified with use with the nurse shark.

The original manipulandum had a rubber lams nipple mounted on clear 0.24 in. (0.64 cm) plexiglass with silicone cement. Two holes were drilled in the plexiglass to allow rear access to the nipple chamber. One hole was for a flexible feeding tube (outside diameter

0.44 in. or 1.1 cm). The other hole was for an adaptor for the air tubing. The tip of the nipple was cut off; the cut end was inverted and stretched over the end of the feeding tube. The area of contact between the nipple and the feeding tube was sealed with silicone to achieve an airtight chamber. The inversion of the nipple allowed the end of the feeding tube to be recessed within the nipple so that the tip of the manipulandum was sensitive to compression.]

One end of the air tubing fit over the adaptor and the other end passed through a hole drilled in a 0.5 in (1.27 cm) sheet of plexiglass until the tip of the tubing extended out the other side about 1 cm. A four inch 8 ohm acoustic speaker was bolted face down on another sheet of plexiglass and sealed. When mounted and sealed, the bite manipulandum and speaker form separate airtight chambers connected by air tubing. Compression of the nipple by a fish bite displaced the speaker membrane so that the speaker acted as a pressure transducer. The signal from the speaker was processed by a circuit (Strength, 1981).

To make the bite manipulandum suitable for use with the nurse shark, several modifications had to be made.

The first modification was the mounting of a rubber cow's nipple onto a 0.38 in (0.97 cm) plexiglass box. The second modification was to increase the size of air tubing. This allowed an increase in the air volume sent to the speaker. A piece of regular air tubing was connected by silicone cement to a 0.75 in (19.91 cm) piece of tubing. Because of the increase in air volume an electronic amplifier was not needed to register the signal to the speaker. A 4 in 8 ohm speaker was placed in an airtight chamber to keep air from seeping through the speaker chamber. To register each signal from the speaker, a DC Milliampere Voltmeter was used. For use with Phase I, a stimulus projection area was placed about the cow nipple. Behind this area, a flashlight used as the light source for the stimuli was placed. The flashlight was connected to two D Duracell batteries. A plexiglass control panel located beside the speaker contained the voltmeter, light switch, and battery pack. The last modification was made before Phase II with the addition of an electric current switch connected to the Duracell batteries. The switch generated the flow of electric current through bell wire, covered with plastic, to be turned off and on. The bell wire was wound around the tip of the nipple.

The next step of the research was to train the nurse shark to bite the nipple on the bite manipulandum. The techniques used in the conditioning of the shark were shaping and chaining. Shaping refers to the process of developing sequence. Chaining is the process of connecting each learned act with reinforcement. Positive reinforcement was given after each successful trial. Reinforcement is a means of strengthening a tendency to perform a certain action. Primary reinforcement is something of first and greatest importance; is absolutely necessary for survival such as food or water. This kind of reinforcement creates the strongest incentive to learn. Food was used as the reinforcement in the research. A continuous schedule of reinforcement is the giving of reinforcement each time a desired behavior occurs. Partial reinforcement is not giving reinforcement continuously (McMahan, 1990).

Two phases were completed in this research with multiple trials in each. Each trial had a set time for the test.

Phase I. Phase one included Trials I, II, and III. A stimulus of light was used in Trial II and III.

Trial I was the first step of the chaining technique. To attract the shark and condition it to eating food out of the nipple on the bit manipulandum, a dummy nipple was used. Fifty tests were run in Trial I. Each test was terminated after 30 second or one response, whichever came first.

Trial II was the second step of the chaining technique. For this trial the bite manipulandum was placed in the water. Food was once again placed in the end of the nipple. As soon as food was placed in the end of the nipple the light was turned on. This stimuli signaled the availability of food. A voltmeter was used in this trial to register when the shark actually bit or blew into the nipple to receive the reinforcement. Seventy-five tests were conducted in Trail II. Each test was terminated after 1:00m minute or one response, whichever occurred first.

Trial III was the last step of the chaining technique. For this trial the bite manipulandum was once again placed in the water. This time only the scent of food was placed through the feeding tube. The scent was used to attract the shark to the manipulandum. For discrimination, as the scent of food was placed in the water, the light (stimulus) was turned on randomly to signal the availability of food. This allowed the data to be analyzed to determine if the shark learned that reinforcement would be given when the light was on. No reinforcement was given for a response that occurred when the light was not on. To read and record each response of the shark, an oscilloscope was connected to the manipulandum. After each successful response, food was given as a primary positive reinforcement. One hundred and fifty tests were conducted for Trial III. Each test was terminated after 1:00 minute or one response. There was about a 30 second period between each test.

Phase II. This phase used a stimulus of an electric current on the tip of the nipple. The purpose of this phase was to determine how effective the electric current would be as a stimulus. The scent of food was placed in the water to attract the shark to the manipulandum. As the scent was placed into the water, the electric current was turned on. Food was given as positive reinforcement after each successful response. Each test was terminated after 1:00 minute or one response. One hundred and fifty test were conducted for Phase II. The oscilloscope was used to record each bite made by the shark.

RESULTS AND DISCUSSION

Phase I. Overall Phase I showed that the nurse shark (*Ginglymostoma*

cirratum) was capable of being "instrumentally conditioned."

Trial I. The data collected from Trial I showed that the nurse shark was able to learn that food would be given each time a bite to the bridge (dummy nipple) occurred. Out of the 50 tests conducted in Trial I, only six tests were terminated before a response occurred. The six terminated tests happened within the first three days of tests. The first day the bridge was used to feed the nurse shark and the shark seemed leery of approaching the nipple. Almost all of the tests took between 20-30 seconds for a response to occur. By the last couple of days of testing, the shark had learned it would receive food if it bit the nipple. The tests also happened much quicker. Overall, the shark bit the nipple 88% of the time during the five days of testing. This trial showed that the nurse shark was capable of learning to bite the nipple to receive food.

Trial II. The data from Trial II showed the nurse shark was capable of learning to bit the nipple on the bite manipulandum. Also, the tests showed that the shark was capable of biting the nipple hard enough to register a response on the voltmeter. The first day the bite manipulandum was placed in the water, the shark was very leery of the machine. Only four tests were successfully completed. The time of the shark's response was very slow. After the four successful tests, the shark continued to run into the manipulandum box for five minutes. Finally, the shark laid in the corner and ignored the machine. By the third day of tests, the shark was learning how to approach the nipple and receive the food. Responses happened much quicker and the shark was starting to bite the nipple hard enough to make the bit register on the voltmeter. Out of 75 tests, only 13 had to be terminated without a response. Overall the shark bit the nipple and received reinforcement 83% of the time.

Trial III. The data from Trial III indicated the nurse shark had learned to bite the manipulation nipple when a stimulus of light was present. Early in Trial III, the shark nudged or bit the nipple when the light was not on. The stimulus of light was present and reinforcement given in 75 tests. The shark bit the nipple 100% of the time during the reinforced tests. Seventy-five non-reinforced tests were conducted. Out of these 75 tests, the shark reacted correctly 93.3% of the time by not biting the nipple. The shark bit the nipple only five times. All five non-reinforced bites occurred during the first three days of testing. A t-test was run comparing the reinforced and non-reinforced tests in Trial III. The statistics were significant to the .001 level. This trial showed that the nurse shark learned to bit the nipple when a stimulus of light was present and the nurse shark also showed progress in recognizing when reinforcement was available.

Phase II. The data collected from Phase II indicated that using an electric current as a stimulus was very effective. Out of the 150 tests conducted, 75 were non-reinforced tests. The shark bit the nipple only twice during the non-reinforced trials. During the reinforced trials the shark bit the nipple 100% of the time. A t-test was run comparing the reinforced and non-reinforced tests in Phase II. The data was significant to the .001 level.

CONCLUSION

The research completed in Phase I showed that the nurse shark (*Gingly-mostoma cirratum*) could be "instrumentally conditioned" for a learned response. Also, the research showed that the modified bite manipulandum could be successfully used to train the nurse shark and obtain reliable response data.

Trial III in Phase I showed that the nurse shark had learned to bite the manipulandum nipple to receive food. This trial also showed the nurse shark was making progress in determining when reinforcement was given.

Comparing testing completed in Trial III of Phase I with Phase II indicated that either a stimulus of light or an electric current could be used effectively with the bite manipulandum in gaining reliable response data.

Further research will be conducted to determine whether variables such as hunger, smell, or location influence the sharks response and response time. Research will also be conducted to determine if there are any additional stimuli that would be effective in conditioning the nurse shark.

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STUDBOOK PETITION

The following material is submitted to the AAZPA Wildlife Conservation and Management Committee (WCMC) in support of a studbook petition for the conservation and management of captive populations of Lake Victoria fishes.

1. Name. Common and scientific name(s) of taxa (genus, species, subspecies, etc.) to be included in the studbook.

Lake Victoria cichlids of the subfamily Haplochrominae. They are considered here as members of the provisional genus *Haplochromis*, and the sister genera *Astatoreochromis*, *Macropleurodus*, *Platytaeniodus*, and *Hoplotilapia*.

Eleven taxa are considered in this application for studbook inclusion. Additional taxa will be added with time. It is estimated that 36 taxa (approximately 10% of the Lake Victoria haplochromine fauna) can be effectively managed among the professional aquariums of North America, Europe, and Africa and not compete unduly with other just causes. A question remains as to whether a representative 10% of the fauna can still be recovered from the wild.

2. Applicant. Applicant's name, professional address, telephone number and AAZPA membership classification.

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AAZPA Professional Fellow

3. Official Status of Wildlife.

The entire species flock of haplochromine cichlids endemic to Lake Victoria is listed by the IUCN as ENDANGERED. The species are not under CITES restriction.

4. Scope of Studbook.

Regional _____ International XXX.

5. Translation Services. Are translation services locally available for maintaining international studbooks?

Yes XXX. No _____

6. Wild Population.

Most of the more than 350 haplochromine species endemic to Lake have become threatened, endangered, or extinct in the last ten years as a consequence of the introduction and population explosion of Nile perch (*Lates niloticus*) (Barel et al. 1985, Ogutu-Ohwayo 1990, Witte in prep). Captive propagation provides a means by which a small portion of the fauna can be salvaged, allowing for continued research and education for at least a few decades. It is also the only means of ensuring that options remain for faunal reconstruction using at least some of the endemic species. The haplochromine cichlids which comprise the bulk of the fauna are important in evolutionary studies, so there is already a considerable amount known about their autecology and taxonomy. Their home, Lake Victoria, has been an object of fascination and reverence since time immemorial: it is the earth's second largest freshwater lake, a source of protein for eight million people, the cradle of early man, and the legendary source of the Nile. Nonetheless, Lake Victoria is only poorly understood in terms of its physical and ecological dynamics. The systematic relationships among the species in the lake are confused, with only about half of the 250 or so known species described, and perhaps half again as many species as yet undiscovered. Most regrettably, resource and fisheries management in this vast riparian region is largely guesswork.

The need to correct this situation has become increasingly graphic in light of the implosive degradation of the Lake Victoria ecosystem over the past decade. Beginning in the last 1920's, imprudent use of gill nets destroyed the lake's two principal fishery species, ngege (*Oreochromis esculenta*, a tilapiine cichlid) and ningu (*Labeo victorianus*, a cyprinid). Starting in 1980, 20 years after its introduction in Uganda, Nile perch populations erupted in a wave that rolled around the lakeshore, reaching the southern Tanzanian waters by 1985 (Barel et. al 1985). Nile perch are immense and insatiable predators, and today the native fishes of Lake Victoria are undergoing mass extinction. About 40% of the taxa identified from Mwanza Gulf, Tanzania are already extinct, or at least unrecoverable, with 90% gravely endangered (Witte, in prep; pers. com.). *O. esculenta*, once the most important food fish in east Africa, is very near extinction; we are presently searching for relict populations that are still believed to exist near the Kenyan-Ugandan border. *L. victorianus* is so severely depleted that its future is uncertain at best, and every other fish species native to the lake is severely depleted, save one. The tiny minnow *Rastrineobola argentea* (umena) has prospered, most probably due to the elimination of its original predators by Nile perch.

The geography of Lake Victoria is depicted in Figure 1, including the sites of origin of founder stock presently represented in the program. Site "A" at Kisumu is the headquarters for field operations by the Lake Victoria Research Team, and the site of sorting and captive breeding efforts in Kenya. Site "B" is the region of origin in Uganda for four of the species in the program (Table 1), and Site "C" is Mwanza Gulf, chief study area of the Dutch/Tanzanian Haplochromine Ecology Study Team, and point of origin for the founder stock of seven of the species listed in this application.

7. Captive Population.

Date on captive populations (a: population estimates, b: distribution by institution) are summarized in Table 1 and discussed briefly under individual species headings. Items c through g are of general nature, and are presented here.

c. Size of potential founder population, if known.

All of the species now in captivity have passed through severe bottlenecks. Although in some cases the present captive population is derived from a group of wild individuals, the number of effective founders is unknown. It is therefore most parsimonious to assume that all captive individuals are descended from a single set of parents. A very high priority has been placed on efforts to recover additional founder stock from the field. The uncertainty surrounding these efforts for any given species makes it essential that the program be initiated immediately with the available material. For some species, such as the planktivore *Haplochromis argens*, it is know that all captive individuals are descended from a single pair or trio, and that the species (formerly of major ecological importance in the lake) is most probably extinct in the wild. Others, such as the undescribed rock-dwelling insectivore *H.* "rock kribensis" have been recently collected from the lake; for these, we are actually in the process of acquiring additional founder stock.

d. Proportion of captive population owned by private sector.

Four private concerns are very actively involved in the haplochromine breeding program: Mr. Russ McAndrews (Boston), Mr. Chuck Rambo (California), Mr. Ole Seihausen (Germany) and Mr. Leif DeMason (Old World Exotic, Inc. in Miami). Collectively they steward approximately 20% of the captive fauna. However, they do so under the direct auspices of the proposed studbook coordinator, and do not "own" those individuals that are actually part of the conservation program.

Many hundreds or thousands of Lake Victoria cichlids are presently held by home aquarium enthusiasts, but these are strictly excluded from the conservation program due to uncertainty regarding their identity, their purity, and their provenance. However, material is deaccessioned from the program to the hobby both when managed species are changed, and when target population sizes for a given species are surpassed and the surplus are not needed for exhibition or research.

e. History of captive propagation, including problems and successes in husbandry, levels of inbreeding, hybridization, etc.

In 1987, the author of this application called for the creation of SSP programs for endangered fish species, stressing the need for a faunal approach. Following the pleas of a conservation-minded consortium of cichlid researchers established in 1985 (IARCEC), Lake Victoria fishes were adopted as a first case study in developing such a program (Kaufman 1987). A preliminary application for a Lake Victoria fishes studbook was submitted in 1989. Progress reports on this initiative were presented in 1988 (Kaufman 1989), and an action plan formulated and endorsed at the 1989 meetings of the CBSG and IUDZG in San Antonio, Texas (see plan, appended). The present document is the application for a Lake Victoria Fishes studbook in final form, reflecting the many useful comments received from preliminary draft review. Certain husbandry issues and concerns regarding hybridization are discussed in Kaufman (1989).

Wild-collected Victorian haplochromines bring with them into captivity a formidable assortment of endoparasites. For the most part these are non-lethal but do impair growth and reproduction. Additional work is needed to develop the best protocol for "cleansing" wild stock. Also, a devastating disease, apparently a form of fulminate septicemia most similar to "Malawi bloat," has been the principal source of mortality in both North American and European (University of Leiden) populations of Victorian haplochromines. The disease strikes sporadically and at irregular intervals, and does not appear to be correlated to levels of care or environmental quality. Efforts are underway to identify the causal agent and develop an appropriate treatment regimen.

Since its inception, the captive breeding program for Lake Victoria Fishes has grown along philosophical lines concordant with the "heritage species program" (HSP) approach advocated by the AAZPA and related organizations at the 1989 IUDZG meeting. The HSP approach is one in which species conservation efforts through captive propagation are married to research, conservation, and education projects in both host and helper nations. The goal of HSP's is to ensure adequate protection of wild habitats and pave the way for the eventual repatriation and long-term stewardship of endangered faunas. The Lake Victoria proto-SSP now consists of three programs. The first is an already established program for the rescue of remaining haplochromines and other endemic species from the lake, and the management of captive populations of representative lineages and ecological types for exhibition, research, and fisheries culture. This application deals with the captive breeding program for haplochromine cichlids. The second component is a laboratory research program focussed upon the phenotypic and genetic changes that take place in captive fish populations, and their implications for species conservation. The third component, the Lake Victoria Research Team, is an international consortium of limnologists and fishery biologists based in Kenya and working under the joint auspices of the Kenya Marine and Freshwater Fisheries Research Institute (KMFRI) and the National Museums of Kenya (NMK). The efforts of the LVRT are directed toward faunal survey, limnology, systems ecology, and visual reconnaissance of the open lake using remote operated vehicles (ROV's).

The LVRT is based in Kenya, but our studies are closely tied to those of sister research groups in Uganda (Ugandan Freshwater Fisheries Research Organization, UFFRO, and the University of Winnipeg) and Tanzania (Tanzanian Fisheries Research Institute, TAFIRI, and the Haplochromine Ecology Study Team of the University of Leiden, called HEST). In essence, we comprise a single research collaborative drawing upon largely independent funding sources to fuel concurrent studies in the three riparian nations.

II. NAMES OF INCLUDED TAXA

Of the taxa presently being managed, the 11 listed below are eligible for, and in immediate need for recognition as AAZPA managed populations. The criteria for petition are: (1) known provenance, (2) known identity, (3) status in the wild assessed as vulnerable, immediately threatened, or endangered, (4) species presently being kept and bred by AAZPA or associated institutions, (5) stock of importance in research or exhibit and thus additionally in need of certification, tracking, and population management. An additional 6 taxa meet all five criteria, and will be added to m program as soon as all participating institutions have had the chance to report on their captive populations. An additional 7 taxa are under consideration, but could not be included in this proposal because they require further study in order to make a species determination and assess the need to manage their populations. 4 taxa have been studied and dropped because they have proven to be non-identifiable, of non-critical groups from a conservation standpoint, of relatively little immediate interest as research of exhibit animals, or suspected of having derived from hybrid or contaminated stock.

All of the following species are members of the Victorian complex of "*Haplochromis*" species. Greenwood (1974) recognized a lineage structure amid this complex species flock and assigned provisional generic distinction to each definable lineage. Data acquired since his classic work, however, indicate that the fauna is in need of further revision. Therefore we follow the lead of the HEST laboratory (Haplochromine Ecology Study Team) in Leiden, in referring most Victorian haplochromines back to a provisional genus *Haplochromis*. This is regarded by all as a temporary and generally unsatisfactory arrangement, and it is still informative to refer to the Greenwood genus with which any given form appears to be most closely allied.

Table 1 - Distribution of Specimens in North American Institutions for Haplochromine Cichlid Breeding Program.

1. *H.* "2-stripe whitelip"

Diagnosis: This is an undescribed species closely allied to Greenwood's *Astatotilapia martini* and *Harpagochromis michaeli*.

As such, it is likely to have been a predator on young fishes and aquatic insects. This species presents a facies intermediate between generalized insectivores and the more specialized piscivorous species of the *Harpagochromis* group. It is superficially similar to *A. martini* as described by Greenwood. "2-stripe white lip" was previously known only from Mwanza Gulf in southern Lake Victoria. Juveniles and females are brassy yellow with two longitudinal dark stripes. Since the brood stock for this petition was originally collected by Bo Selbrink in Uganda, the species must have occurred in both northern and southern portions of the lake. Van Oijen (unpubl.) includes these three species in a group along with two other undescribed forms from Mwanza Gulf, tentatively named "2-stripe yellow-green" and "2-stripe too-small." A detailed taxonomic description is in preparation by M. Van Oijen of HEST.

Status: "2-stripe white lip" appears to be extinct in the wild.

Trade Names: The individuals in the program were ordered from Bo Selbrink in Sweden under the trade name "Prognathochromis" "all-yellow." It is apparent that the fishes referred to by Selbrink as *Astatotilapia martini* were sent in lieu. The taxon originally dubbed "all yellow" by Selbrink is being held at the Shedd Aquarium in Chicago, where last-ditch breeding efforts for the 2.7 individuals are under way. The true "all yellow" appears to be a large paedophage (which in any event exhibits a blue-black male coloration) that entered the program separately. All known material presently in the US under the name "*A. martini*" are probably assignable to "2-stripe white lip."

2. *H.* "rock kribensis"

Diagnosis: "Rock kribensis" is an undescribed, insectivorous member of the rock-dwelling haplochromine community in Lake Victoria. It derives its name from a superficial similarity in pattern to the pelagic phytoplanktivore *H. kribensis*. The coloration of "rock kribensis" is distinctive. Females and juveniles are golden yellow. Adult males have a chamois ground color with brilliant orange or orange-red flanks, the entire body overlain with a dusky blue-black color that darkens in death to black. Both sexes at all stages display a characteristic plaid appearance dorsally due to the presence of both vertical bars and longitudinal stripes. A detailed taxonomic description is in preparation by E. Witte-Masse of HEST.

Status: Like most of the rock-dwelling haplochromines, "rock kribensis" has not been as severely affected by Nile perch introduction as have most other Victorian species. We consider it vulnerable until evidence is obtained to indicate that it should be considered secure. The brood stock indicates that the species was present in both northern and southern reaches of the lake at least as recently as the early 1980's. Justification for studbook inclusion is based on uncertainty as to the future of any Victorian endemic, the fact that this is an attractive species of educational value, and the need to manage stocks for research.

Trade Names: "Rock kribensis" was collected in Uganda by Bo Selbrink, bred in Sweden, and F1 fry exported to the US as "*Astatotilapia barbarae*," a very different-looking, behaviorally

specialized egg-stealer that is not presently known in captivity.

3. *Haplochromis perrieri*
Diagnosis: This relatively small, pleasingly colored piscivorous species is a member of Greenwood's *Prognathochromis* group of elongate, specialized piscivores. HEST originally referred specimens of this species from Mwanza Gulf to the provisional taxon "erythrops" in reference to the reddish eye, but eventually the species was determined as *H. perrieri* Pellegrin, a species not considered by Greenwood (1981). Brood stock collected in Uganda by Bo Selbrink points to an originally lake-wide distribution for the species.
Status: *H. perrieri* is presently considered extinct in the wild.
Trade Names: F1 individuals of this species were exported from Sweden by Bo Selbrink under the trade name *Prognathochromis pellegrini*, to which *H. perrieri* bears a superficial resemblance in shape and small adult size (for a piscivore).

4. *Haplochromis* "thick skin"
Diagnosis: "Thick skin" is an undescribed, probably insectivorous haplochromine of inshore rocky reefs and vegetated shorelines in Lake Victoria. In coloration it bears a superficial resemblance to Greenwood's description of *H. lividus*, but differs in gut length and dentition among other characters. "Thick skin" is known from Mwanza Gulf (south), Entebbe (north), and specimens of appropriate coloration and morphology to be this species were observed at Kisumu (east); the species probably still enjoys a lakewide distribution in shallow, marginal waters.
Status: As for "Rock kribensis," vulnerable.
Trade Names: Collected by Bo Selbrink in Uganda and F1 fry exported from Sweden under the name *Haplochromis obliquidens*, to which it bears little or no resemblance. Based on male coloration, specimens in the AAZPA breeding program were tentatively referred to as *H. lividus*.

5. *Haplochromis ishmaeli*
Diagnosis: *H. ishmaeli* is among the more derived members of Greenwood's *Labrochromis* group of pharyngeal snail-crushing haplochromines. Brood stock collected by HEST from Mwanza Gulf form the basis of the captive population.
Status: All members of the pharyngeal-crushing guild are considered Endangered. Pharyngeal crushers can still be found in the lake; this species, however, has not appeared in recent collections from either Tanzanian or Kenyan waters. It was reasonably common as late as 1985. Ugandan collections have not yet been examined. *H. ishmaeli* is of considerable importance as a research animal, and is a good exhibit species.
Trade Names: Bo Selbrink exported something under this name, and some individuals may still be floating through the aquarium trade. These have been excluded from the managed population as a cautionary measure.

6. *Astatoreochromis alluaudi*
Diagnosis: This is the largest representative of a small genus (3 probable species) of mostly riverine and swamp-dwelling pharyngeal crushers from east Africa. Originally endemic to the Lake Victoria Basin, *A. alluaudi* has been introduced widely in tropical Africa as a possible biological control agent for the snails that carry bilharzia. The ploy has not worked, due to the species' now infamous capability to alter its dentition and skeletal architecture in accordance with its diet, hence losing both the capacity and the predilection for eating snails when other foods are available. *A. alluaudi* is immediately distinguishable from all sympatric haplochromines by having more than 3 anal spines, reduced sexual dimorphism, and the beautiful gold, green and red coloration of sexually active males.
Status: This species is not in any immediate danger in the wild due to its wide distribution. Stock from Lake Victoria is in dire need of management, however, due to its growing importance as a laboratory research animal for studying the mechanics, physiology, and genetics of skeletal plasticity. Scientists from Holland, the US, Belgium, and Canada have agreed to focus joint attention upon individuals from Mwanza Gulf of Lake Victoria (which are molariform in the wild) to permit synthesis of data and result.
Trade Names: Members of the genus *Astatoreochromis* have appeared in the trade several times over the past 15 years; usually they are misidentified and there is still some confusion over the status of *A. vanderhorsti* and *A. straeleni*, the two non-Victorian species. Most individuals seen in the trade are of the non-molariform phenotype and are of unknown provenance, rendering them unsuitable for research purposes.

7. *Haplochromis sauvagei*
Diagnosis: This is a member of Greenwood's *Ptyochromis* lineage of snail-eating species, known for "winkling" or extracting snails from their shells by snaring the foot with elongate, recurved buccal teeth and snapping the meat out by means of vigorous shaking of the head. Present brood stock is from Mwanza Gulf.
Status: Threatened, possibly Endangered.
Trade Names: An unidentified species, probably of the *Ptyochromis* group, was collected in Uganda by Selbrink and exported from Sweden as *Ptyochromis sauvagei*, which it is not. It has appeared in the trade under this name. A large population of this form derived from F1 stock is being maintained at present in this program. It is being retained pending further determination under the temporary name "Selbrink sauvagei."

8. *Haplochromis xenognathus*
Diagnosis: This is another *Ptyochromis* with an unusual, retrograde lower jaw that gives the fish a "chinless" look. *H. xenognathus* is the nucleus of a complex of forms varying slightly in morphology, and profoundly in male mating colors.

Present brood stock is from Mwanza Gulf, but additional material has been imported live from Kenya for our program, and is awaiting study in Miami.
Status: Forms referable to this species are among the more frequently caught haplochromines on sandy beaches in both Tanzanian and Kenyan waters of Lake Victoria. It is uncertain, however, how many taxa are actually represented by these specimens. In view of its greatly reduced abundance, this species is considered Vulnerable.
Trade Names: To the best of our knowledge, only Mwanza Gulf (Leiden brood stock) material is available at all, and this not present in the general trade.

9. ***Platytaeniodus degeni***
Diagnosis: A monotypic genus bearing some similarities to the *Ptyochromis* line. Brood stock is Mwanza Gulf origin, via Leiden.
Status: Tentatively considered Endangered, although it may in fact be extinct.
Trade Names: No trade stock known.

10. ***Haplochromis piceatus***
Diagnosis: This species is a low-water column zooplanktivore that has experience severe dwarfing since Nile perch introduction. Brood stock is derived from Mwanza Gulf via Leiden.
Status: Formerly, it was of great abundance. Presently its status is uncertain, but the species should be considered Endangered.
Trade Names: None.

11. ***Haplochromis argens***
Diagnosis: An elongate, surface-dwelling zooplanktivore once present lakewide in large numbers.
Status: Believed Extinct in the wild.
Trade Names: None.

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