NEWSLETTER

of the Introduced Fish Section
American Fisheries Society

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NEWSLETTER CONTENTS

MESSAGE FROM THE PRESIDENT

This will be short because I haven't done much; I find it much more satisfying to edit a newsletter (resulting in a tangible product) than to try to lead IFS to bigger and better things.

In the next few months I plan to devote some time to the problem of ballast water introductions. The well publicized invasions of the Great Lakes and the less well known, but equally disastrous invasions elsewhere have aroused some interest in attempting to regulate the use of ballast water in ships. IFS could play an important role here and one the first things that needs to be done is to draft a policy statement for the parent society to adopt. It could then be used as a basis of specific recommendations to the federal agencies that could regulate use of ballast water.

Speaking of ballast water, do you have some mental ballast you would like to unload? We are always looking for interesting items for the newsletter, to make it worth the vast sums you spend on membership in IFS. Tell us of your latest invader, your problems/successes with introduced species, or why you are disgusted with IFS. Paul and I look forward to hearing from you.

--Peter Moyle

FROM THE EDITOR

Interest in purposefully introducing fishes is increasing as evidenced by proposals ranging from rainbow smelt in the Colorado River, zander

in North Dakota, bighead carp in Illinois, peacock bass in Florida, Nile perch in Australia ... to tilapia everywhere! Too often such proposals are judged superficially, the conclusion being made before one finishes reading the title. Some argue against all introductions using parochialistic generalizations while others have proposed introductions with little more forethought.

Most people agree that the socio-economic and biological effects of fish introductions are not only species specific but also habitat specific. That is, the same fish introduced in different places can have different effects. A further complication is that the effects of an introduced fish are often judged beneficial or detrimental depending on whether or not one's personal biasness leans toward that of a puristic ecologist, environmentalist, commercial fisherman, aquaculturist, sportfisherman or fisheries manager. If this were not so could the debate over common carp continue seemingly <u>ad</u> <u>infinitum</u>?

Finally, it seems easy to avoid realistic risk assessment analyses when evaluating introductions by relying too heavily on potential effects whether catastrophic or beneficial. Of course, the greatest detrimental environmental effects have been the result of our own (selfish?) desires to live comfortably in air-conditioned homes, to be transported rapidly and luxuriously where and when we want to be, and to be left alone to do our own particular thing, preferably using waste products easily disposed of but not necessarily biodegradable. By comparison to deforrestation, wars, the greenhouse effect and environmental damages caused by over-population, the identified consequences of fish introductions seem miniscule. Nonetheless, this in no way relieves us of our responsibility nor the importance of protecting our remaining aquatic resources. In fact it seems this responsibility is even greater and more important today than ever before.

Enough epistemologizing ... (is that really a word?)! I do hope this year's IFS Newsletter encourages each of us to examine our philosophy on introductions through exchanges with those who differ. As a novice editor, I suggest this knowing J.L. McLean (an experienced editor) recently wrote "The last time I mentioned introductions ... I was threatened with libel ..." [Naga/The ICLARM Quarterly 11(4):2]. If needs be, I do know how to crawfish on an issue, so feel free, and be encouraged, to share your insights into these matters in future issues of this Newsletter.

--Paul Shafland

ARMORED CATFISH APPEAR IN HAWAIIAN FRESHWATERS

Since 1984 at least three genera of South American armored catfish, Family Loricariidae, have been accidentally introduced to the island of Oahu, State of Hawaii. Pterygoplichthys sp. (radiated ptero) and Ancistrus sp. (bristle-nosed catfish) are now abundant in many reservoirs. Hypostomus sp. (suckermouth catfish) has been reported from widely separated streams. The first two genera are definitely firmly established and are expanding in distribution. The status of Hypostomus is less certain. No loricariid was recognized in the last comprehensive listing of exotic fishes in Hawaii (Maciolek, J.A. 1984. Exotic fishes in Hawaii and other islands of Oceania. In, Distribution, Biology, and Management of Exotic Fishes. Ed. by Courtenay, W. R., Jr., and Stauffer, J.R., Jr. Johns Hopkins Univ. Press, Baltimore and London. pp. 151-161).

Over the past two year P. multiradiatus (identified by Gordon Howes, Dept. of Zoology, British Museum) has exploded in abundance in the Wahiawa Reservoir, a v-shaped impoundment about 14 km in length and 25 m in depth on central Oahu. Wahiawa supports Hawaii's largest public fishery. In January of 1986 an angler on the reservoir snagged a single specimen about 360 mm TL for the first record of the species in the islands. In August of 1986 a second specimen approximately the same size was captured in a beach seine. Anglers began to report sighting of the fish later in the year.

In June of 1987 individuals less than 25 mm TL frequented the shoreline during the day. Nocturnal spotlighting found that in some areas virtually all hard submerged surfaces were covered with masses of armored catfish. Reflections of the spotlight by the red irises of their eyes gave the appearance of innumerable underwater lasers. The eyes of even the tiniest fry were glaring bright to the very edge of the spotlight beam.

Tunnel construction by the fish was first observed in August of 1987. By the summer of 1988 banks exposed by declining water levels were honeycombed with deserted armored catfish tunnels, and the fish had become one of the most abundant species in the reservoir. Intensive spawning resumed in June and continued to October. Surveys of lower elevation reservoirs found that it was widespread throughout northern Oahu.

Most adults ranged from 250 mm to 450 mm TL in 1988. The largest specimen collected was 650 mm TL. A relationship was derived that permitted the calculation of fish length from the width of the tunnel opening. Resultant size distribution analyses supported the view that the armored catfish has been established in the Wahiawa Reservoir for less than four years.

The full impact of its occurrence in reservoir and stream habitats has yet to be ascertained. It has occupied an open niche in Hawaiian reservoir habitats by virtue of its bottom-dwelling, mud-eating habits and has dramatically expanded that niche through its tunneling behavior. It has not as yet exhibited a similar propensity for occupation of stream habitats.

Although it was unquestionably imported by the aquarium fish trade for its tank cleaning capability, a more useless beast is hard to imagine. It has no sport fish value. It cannot be taken on hook-and-line, except by sheer accident. It cannot be skinned or scaled, and its ugly appearance would deter most persons from cooking it intact.

A technical review of the introduction in association with other species is available (Devick, W.S. 1988. Disturbances and fluctuations in the Wahiawa Reservoir ecosystem. DJ JPR F-14-R-12, Job 4, Study I. 48 pp.). Preparation of a comprehensive report is underway.

--Bill Devick, Hawaii Department
of Land and Natural Resources

WORLD RECORD BROWN TROUT

A monstrous 39-pound, 9-ounce brown trout taken in Arkansas' Norfork River has shattered the previous world record of 35 pounds, 15 ounces set in Argentina in 1952.

Mike Manley caught the 39-inch fish, whose girth measured 27-3/4 inches, just after midnight with a five-foot ultra light outfit. Mike's treble hook was baited with corn and marshmallows and he was fishing from the end of a very popular boat dock. The marshmallow was not on the hook but was used as an edible float to keep the corn-baited hook from getting scummed up in the algae.

Arkansas fishery biologists are excited as the event substantiates what they have been claiming for years: North Central Arkansas has one of the best brown trout fisheries in the world.

--SFI Bulletin No. 398,
September 1988

TEXAS FEELING EFFECTS OF FLORIDA BASS

The Texas Parks and Wildlife Department reports that introduction of a Florida-strain of largemouth bass has had a positive impact on Texas' inland sport fishery. Caddo Lake in northeast Texas recently has been added to the list of inland waters in the state to receive recognition for increased production of trophy-sized fish as a result of the genetic impact from the introduced specie.

Biologist Tim Schlagenhaft of the Texas Parks and Wildlife Department said Caddo, Texas' largest natural lake, has been popular with bass fishermen for decades. "While anglers have always caught good numbers of bass, they often complained about the absence of larger fish," Schlagenhaft said. "Now, however, anglers and concessionaires report an increase in the number of big bass being caught."

While five-pound bass were considered a rarity before, the lake now is producing many in this size class. During 1988, two bass weighing more than nine pounds each were reported taken from Caddo.

"Surveys indicate that the introduction of Florida bass into Caddo probably is responsible for the increase in trophy-sized bass," Schlagenhaft said, "Floridas' stocked in 1981 and 1982 have had a strong genetic impact on the population," the biologist said. "An electrophoretic survey in November 1987 showed that 33 percent of the largemouths sampled contained the Florida gene," he said.

The impact of Florida bass on trophy bass production is well documented, Schlagenhaft reported. A total of 49 of the 50 biggest bass taken in Texas have been caught since Florida bass were first stocked in 1972. Of those top 50, 10 have been analyzed using electrophoresis, and all contained the Florida gene.

For information about recreational fishing and camping facilities at Caddo Lake State Park, write to: Caddo Lake State Park, Route 2, Box 15, Karnack, Texas, 75661, or call (214) 679-3351.

--SFI Bulletin No.398,
September 1988

INTERIM REPORT ON THE FERTILITY OF TRIPLOID GRASS CARP

Grass carp (Ctenopharyngodon idella) are acknowledged as effective biological controls of aquatic vegetation, but regulatory agencies formerly prohibited widespread introductions from fear of natural reproduction and possible adverse impact on native fish species. Development of the presumably sterile triploid grass carp resulted in a more permissive attitude; therefore, certified triploid grass carp were subsequently stocked in eight states and are being considered for stocking by many others. Reported spawning of triploid grass carp in the Imperial Valley, California, (N. Hagstrom and J. von Eenennaam, personal communication, 1987) stimulated this research effort in which the fertility of 4-year-old triploid grass carp was evaluated by induced spawning.

Obvious fertility differences existed between diploid and triploid grass carp. All diploid fish used in this study were sexually mature, had abundant eggs or copious milt, and were capable of spawning. Three of seven triploid females and three of eleven triploid males exhibited egg or milt production that indicated reproductive competence; these fish were induced to spawn. The remaining triploid fish had undeveloped gonads and did not respond to hormone administration. Fourteen triploid females died from handling stress before spawning; two of those showed significant ovarian development. Four mature diploid and one mature triploid female failed to ovulate, perhaps due to an insufficient dose of gonadotrophic hormone.

All possible pairings between diploid and triploid forms were obtained from 14 individuals, resulting in 17 crosses. Fertilization and hatching success were not estimated for crosses involving only diploid fish, but historical hatchery records indicate that 40-50 percent hatching success can be expected. Fertilization success of crosses involving only triploid gametes ranged from 0-54 percent, but survival to hatch was less than 0.5 percent in all cases. Ploidy analysis of hatched larvae from all-diploid crosses resulted unexpectedly in 21 percent spontaneous triploid and 79 percent diploids (n = 40), while larvae from all-triploid crosses were 100 percent triploids (n = 10). Diploid x triploid crosses resulted in predominately aneuploid (2.4-3.4C) offspring.

Undeniably, some triploid grass carp mature sexually and produce gametes that are capable of fertilization; the percentage of a population that is reproductively competent remains to be fully documented. Whether any of the triploid grass carp used in this study would have spawned without hormone stimulation is not known. Further, more rigorous quantification of offspring survival from all-triploid and triploid x diploid crosses is needed. While it may be unsettling to acknowledge that some triploids can reproduce, the low viability of offspring produced in the present study lends support to the conclusion that triploid grass carp are functionally sterile. This research was conducted in cooperation with personnel of the Florida Game and Freshwater Fish Commission (Harrel Revel, Chuck Starling and Bob Wattendorf) and flow cytometry analysis was performed by Rick Aldridge, Dept. of Fisheries and Aquaculture, University of Florida.

Reprinted excerpts from: C. Goudie. 1988. Some triploid grass carp can be induced to spawn. Research Information Bulletin No. 88-24. National Fisheries Research Center, 7920 N.W. 71st Street, Gainesville, FL 32606 (telephone 904-378-8181).

USFWS TO CONTINUE CERTIFYING TRIPLOID GRASS CARP

U.S. Fish and Wildlife Service's Frank Dunkle writes "Thank you for your letter of December regarding AFS concern that the Fish and Wildlife Service plans to discontinue its triploid grass carp certification program. Upon further review, I have decided to continue the certification service and appreciate the recent support expressed by you for the Service's past efforts."

--The AFS Dairy 15(1)
January 6, 1989

LAKE CONROE GRASS CARP FINDINGS

In 1979, hydrilla covered over 1,800 ha (4,500 ac) or 23 percent of

Lake Conroe, an 8,100 ha (20,000 ac) reservoir in southeast Texas. In 1979, the Texas Legislature directed the Texas Agricultural Experiment Station, of the Texas A&M University System, to determine the effects of macrophyte control using grass carp in Lake Conroe, and to monitor the reservoir's limnology and fish populations.

A total of 270,000 grass carp averaging 20-30 cm long (8-12 inch) were stocked into Lake Conroe beginning in September 1981, at a density of 74 fish per vegetated ha (30/ac). At that time submersed aquatic macrophytes (about 90 percent hydrilla) had increased to cover about 3,600 ha (9,000 ac) or 45 percent of the reservoir's surface area. By the time stocking was completed (September 1982), a reduction in hydrilla coverage was already evident and by summer 1983, virtually all submersed aquatic macrophytes had been removed by the grass carp.

Limnological responses to complete macrophyte control became evident in summer 1983. Phytoplankton density increased concurrent with increased concentrations of nitrate nitrogen, ammonia nitrogen, sulfate, orthophosphate and total phosphate. The phytoplankton community was dominated by cyanophytes (blue-green algae) throughout the study. Zooplankton density declined following macrophyte removal.

The limnological factors which appear to be clearly associated with macrophyte removal are: loss of the invertebrates associated with the macrophytes, loss of the primary productivity of the macrophytes and their attached algae, a decrease in water clarity, an increase in chlorophyll a in the open water, a pulse of available nutrients in the water, and a short-term increase then decrease in zooplankton density.

There were both direct and indirect effects of macrophyte removal on fish populations in Lake Conroe. Increased vulnerability to predation, in concert with the indirect effect of reduced food supplies (in the form of littoral invertebrates), was likely responsible for the reduction in abundance and diversity of sunfishes observed after macrophyte removal. Other forage fish species, presumably better adapted for survival in open habitats (e.g. shad, longear sunfish and several minnow species), were significantly more abundant after macrophyte removal. The increased biomass of these species did not offset the reduced biomass of most sunfish as total forage fish biomass decreased about 60 percent after macrophyte removal.

Largemouth bass food habits indicated prey availability was reduced by the presence of aquatic macrophytes. In 1980-81, young largemouth bass switched to a fish diet (piscivory) at a length of about 125 mm. Following macrophyte removal and increased prey availability, piscivory was initiated by about 75 mm total length. Additionally, average size of prey consumed by largemouth bass (of a given size) increased following macrophyte removal. This increase in prey availability was likely the cause of increased first-year growth of largemouth bass, although density-dependent factors may also have contributed to this effect.

The numbers of young largemouth bass were reduced after 1983, probably due to increased vulnerability to predation and decreased densities of invertebrate food. Abundance of young largemouth bass was poorly correlated with the abundance of adults in subsequent years. Macrophyte presence or absence had no effect on largemouth bass growth after age-1. Although density of age-1 largemouth bass declined following macrophyte removal, changes were not evident in either the density or biomass of harvestable largemouth bass greater than 240 mm in length.

Angler catch rates (fish/hour) were highest prior to macrophyte removal for both largemouth bass and crappie. Tournament catch rates of largemouth bass were positively correlated to macrophyte coverage. Following macrophyte removal, mean weight of harvested largemouth bass increased. However, harvested pounds of largemouth bass per hour declined between 1980-81 and 1985-86. Crappie catch (numbers and weight) varied considerably among years, presumably reflecting variable year-class strengths. Crappie catch rates also declined during the study period.

Complete control of the submerged aquatic macrophytes in Lake Conroe resulted in a production shift from a macrophyte-based system to a phytoplankton-based system. Concurrent with this change was an increased importance of open-water fish species (both prey and predator species) and a change in abundance and species composition of fishes in the littoral zone (i.e. nearshore). It is unlikely that the system had stabilized by 1986 and the long-term ecology of the system will be influenced by such factors as vegetative regrowth, the survival of grass carp, and the development of new predator-prey relationships in the changed system.

> Executive Summary excerpts from Klussmann, W.G., et al. 1988. Control of aquatic macrophytes by grass carp in Lake Conroe, Texas, and the effects on the reservoir ecosystem. Texas Agricultural Experiment Station. Department of Wildlife and Fisheries Sciences. Texas A&M University, College Station, Texas 77843, 61 pp.

TILAPIA RULE CHANGE IN TEXAS

Nick Carter (Past IFS President and Chief, Inland Fisheries, Texas Parks and Wildlife Department) writes that "Effective January 1, 1989 the Texas Parks and Wildlife Department returned two species of tilapia (T. aurea and T. mossambica) to the State's Potentially Harmful Fish List. These rules were the result of considerable scientific investigation into the status of tilapia in Texas Waters and a special tilapia conference in March 1988. Litigation is pending as a result of these new tilapia rules."

TILAPIA IN TEXAS WATERS

Maurice I. Muoneke

ABSTRACT--Blue tilapia Tilapia aurea, a cichlid native to Africa, is the most wide-spread of three exotic tilapias in Texas waters. Other African cichlids found in the state include Mozambique tilapia T. mossambica and redbelly tilapia T. zilli.

Tilapia prefer water temperature of 30°C (86°F) or warmer and generally die at water temperatures below 10°C (50°F). Most large tilapia populations are found in power plant reservoirs.

By 1978, tilapia were present in 14 reservoirs and three rivers in Texas. In 1979, blue and Mozambique tilapia were removed from the restricted fishes list because they were already established in several water bodies. Since that time, the number of invaded water bodies has increased to 30 reservoirs, four rivers and parts of the lower Laguan Madre system.

Tilapia are tolerant of poor water quality, they have multiple spawns per year and the mouthbrooding species provide more parental care than native fish species. Consequently, they have high survival rates and often establish large populations in waters suitable for their survival.

The major ecological impacts of high population densities of tilapia include spawning repression among sport fish, especially largemouth bass, and competition for forage with juvenile largemouth bass and other important fishes. Spawning repression has occurred in at least two Texas reservoirs. Winter kills of tilapia removed the repression.

There is a minor sport fishery for blue tilapia in Texas with the fish taken primarily by cast nets, seines and bow and arrow. Creel data indicate the fishery has been realized in only two reservoirs and the majority of the tilapia are taken by a very small percentage of anglers.

Feasibility studies on the commercial exploitation of blue tilapia in reservoirs indicate the demand and price are both good, but that the supply is limited during the warmer months of the year because of population dispersal. A more reliable supply is being provided by fish farmers. There are an estimated 20 tilapia producers in the state that devote 45% of their tilapia crop to the food consumer market.

> Reprinted by permission of Nick Carter. The full text is available from Texas Parks and Wildlife Department, Fisheries Division, 4200 Smith School Road, Austin, Texas 78744. Ask for Inland Fisheries Data Series No. 9, 1988.

RESOLUTION

The Fish Genetics Section of the American Fisheries Society

POSSIBLE GENETIC EFFECTS ON FISHERY RESOURCES BY AQUACULTURAL ACTIVITIES

Whereas, aquaculture in North America is an increasingly valuable and significant economic resource; and

Whereas, the stewardship of our natural resources is a shared government and private sector responsibility; and

Whereas, the management of fishery resources, including populations, strains, and stocks of fishes and other aquatic organisms, at the government and private sector levels is often fragmented; and

Whereas, aquaculturally developed species, including introduced, hybrid, and genetically engineered organisms, have the potential to negatively affect the genetic integrity of these fishery resources, if sound methodologies are not employed to control escapement, placement, disease, and hybridization;

Now, therefore, be it resolved, that the Fish Genetics Section of the American Fisheries Society, although it supports responsible aquacultural development, including genetic engineering, emphasizes that these developments must not compromise the genetic integrity of our naturally reproducing fishery resources;

And be it further resolved, that the Fish Genetics Section of the American Fisheries Society recommends that the Parent Organization establish procedures and guidelines to evaluate the potential genetic impacts of organisms proposed for aquaculture on naturally reproducing populations of aquatic organisms;

And be it further resolved, that the Fish Genetics Section of the American Fisheries Society at their 1988 Annual Meeting in Toronto, Ontario, recommends that the Parent Organization adopt a similar resolution concerning the potential genetic impacts of aquacultural activities on fishery resources.

Julie E. Claussen, Secretary — 27 October 1988

ASIAN CARPS ENTER ILLINOIS COMMERCIAL FISHERIES

In 1987 Illinois commercial fishermen caught 1961 pounds of bighead carp from the Mississippi River. This was the first year commercial catch records were kept for bighead carp. Grass carp (white amur) catch statistics have been kept since 1983; during which time they averaged 15659 pounds and ranged from 10708 to 23928 pounds per year. Grass carp have been taken as far north as Prairie Du Chien, Wisconsin while bighead carp were collected as far north as Pool No. 24, about 28 miles north of St. Louis.

--Bill Fritz, Illinois Department of Conservation

BIGHEAD CARP IN ILLINOIS AQUACULTURE?

Reprinted below is a paper prepared by Steve Waite for the Illinois Aquaculture Industries Association at the request of the Illinois Aquaculture Advisory Committee. Steve represents the organized private fish farmers of Illinois as the Association's President. This group is requesting that bighead carp be legalized for use by private aquaculturists. Peter Moyle (current IFS President) was asked to comment on the proposal by the Illinois Department of Conservation; his response is also reprinted below. This proposal is provided for informational purposes only as Steve had not originally anticipated it being widely distributed. If you have any question he can be reached at 217-351-4108. A final decision on whether or not to allow bighead carp culture is expected to be made soon. For more information contact Rodney W. Horner, Aquaculture Coordinator, Illinois Department of Conservation, RR 4 Box 54, Manito, IL 61546 (telephone 309-968-7531).

A Position Statement in Support of Legal Importation/Possession/ Culture/Sales of the Bighead Carp (Hypophthalmichthys nobilis) for Commercial Aquaculture in Illinois

The correct scientific name of bighead carp is Hypophthalmichthys nobilis, which was chosen and recognized in 1988 by the American Fisheries Society's Committee on Names of Fishes. Oshima in 1919 established the genus Aristichthys to contain the species nobilis on the basis that differences in gill raker form, abdominal keel position, and pharyngeal dentition between nobilis and molitrix warranted separate genera. But in 1981, Howes reported that nobilis and molitrix have "unique synamorphies" and therefore belong to the same genus Hypophthalmichthys. No subspecies of H. nobilis are recognized. The English common name is bighead carp, or simply bighead.

Endemic to eastern China, the bighead carp has been introduced to more than 30 countries worldwide with 10 such introductions occurring since 1970. The first bigheads were imported into the United States by a private-sector fish farmer in 1972 to improve water quality in aquaculture ponds. Understanding that bigheads could be very beneficial to pond aquaculture, but armed with legitimate concerns regarding what changes might occur in native populations if this species escaped, the Arkansas Game and Fish Commission began evaluating bigheads and other Chinese carps in 1974. Meanwhile, restrictions were

enforced to prevent escapes from private waters and methods were formulated to kill established populations in public waters.

Introductions of bigheads, like other imported Chinese carps have caused controversy in virtually every state. The rational behind legal constraints is ecologically based, and centers on the fear of escape, and ensuing natural reproduction and consequent establishment, which may alter habitat, trophic, and spatial states, as well as to introduce parasites and diseases. Advocates of bighead importation suggest that no spawning will occur in lentic environments, and therefore accidental releases or escapements could not generate new populations, nor compete with nor negatively impact mature fish communities. Opponents counter with the argument that no one can absolutely guarantee a "no-escape" situation; as in Murphy's Law, if it is possible that fish could escape, more than likely they will--and eventually to river systems where successful reproduction is possible.

In the first decade of its existence in the United States, the bighead was little more than a curiosity, with most interest coming from academic circles. We were fascinated with the fish's ability to effect plankton removal and control, to stimulate nutrient uptake, and to contribute toward a highly efficient polyculture production system. Only since the mid-1980's, has the private sector recognized the large market demand and upwardly spiralling potential for bighead carp as a food fish in the United States and other countries.

This rather sudden interest and participation in the culture of bigheads by increasing numbers of private aquaculturists has conflicted with certain state and federal regulatory agencies that disapprove of exotic fish importations. In Illinois, state regulations forbade private sector use of Chinese carps for any purpose until 1986, when the triploid grass carp was approved for control of aquatic vegetation in private waters. Since then, Illinois aquaculturists have asked the State to relax their restrictions on the bighead because profits are being made in adjacent states that have few or no restrictions for such activities. From an economic viewpoint, the current legal constrictures on possession of this species in Illinois significantly affects the economy of the Illinois aquaculture industry and reduces our ability to compete in regional or national markets, both in the short and long term.

The purpose of this paper is to articulate the case in support of legalizing importation, culture, and sale of the bighead carp in Illinois.

To establish the groundwork for this case, we will use a simplistic version of a protocol offered by Kohler and Stanley (1984) that employs a "review and decision" model. Whether undertaken by state natural resource administrators or by ecologically-responsible aquaculturists, the process must be the same, i.e., many elements must be considered in evaluating the bighead carp for legal importation/possession. We will show in the following protocol that importation of bighead carp will represent minimal risk to both natural aquatic and human populations when used in permitted aquaculture facilities under reasonable constraints by the state.

Level of Review I

*Validity of importation--The bighead carp will be used in Illinois aquaculture facilities for the same reasons of which it is recognized worldwide: in addition to being a versatile and very important food fish, it controls plankton blooms, which improves water quality and ultimately increases production potentials of target species.

*Potential for inadvertent introduction of diseases and parasites--Bighead carp worldwide suffer from a plethora of disease-causing agents including two bacteria, one fungi, 22 protozoans, six trematodes, three cestodes and three copepods. However most outbreaks occur in high densities in controlled facilities. We believe that diseases or parasites inadvertently from single escapee into public waters would be extremely remote. Reasonable safeguards, as used with other aquaculture species, will be used to prevent the spread disease-causing agents to other facilities and public waters.

*Site of proposed introductions--Bigheads will be cultured in self-contained tank or pond facilities that use reasonable mechanisms to prevent intentional or unintentional loss from the facility. Obviously, facilities lying in the immediate vicinity of stream/river environments have a greater chance of escape to such environs than a facility in the middle of a corn field and 3 miles to the nearest drainage ditch. Aquaculturists cannot afford any loss from an economic standpoint, so those acting within the law as permitted aquaculture facilities will take the necessary precautions to prevent live escape.

Decision Point #1

-Are reasons for introduction valid? YES

-Is the bighead carp endangered, threatened, or rare in its native environment? NO

-Would adequate safeguards be taken to guard against introduction of disease and parasites? YES

-Would the bighead be maintained in a closed system with little chance of escapement? YES

(The answers to these questions could be sufficient to approve introduction of the bighead, but we shall proceed to Level of Review II of the protocol.)

Level of Review II

*Determine acclimatization potential--This refers to the likelihood that a particular exotic species could form a self-sustaining population within the range of potential habitats. Optimum temperatures for bigheads are 20-30 degrees with 10 degrees C near cessation, but considering their native range in China, these fish tolerate temperature extremes in both temperate and tropical locales. Although the above temperature regimes can easily be accommodated in Illinois, the bighead's strict reproductive requirements preclude any

chance of this species reproducing in any Illinois reservoir or impoundment or lotic system with current velocities less than 0.8 meters per second. A third concern here is the potential of the exotic to compete with other fishes for the same food resource. If a self-sustaining population could develop, then these fish, being phytoplanktivorous and zooplanktivorous (mainly the latter), could compete in a localized area with native buffalo, shad, paddlefish, and zooplankton-consuming fry and fingerlings of various species. Single escapees of bigheads into either lentic or lotic environments in Illinois would probably have a minimal, if not immeasurable, impact on native populations.

Decision Point #2

-Would bighead carp be able to survive and reproduce in the range of habitats that would be available? YES and NO, respectively. This takes us to Level of Review III.

Level of Review III

*Predict ecological benefits and risk--Ecological benefits of bighead carp in Illinois waters are difficult to determine because of a lack of information. Certainly the benefits (ecologically and othewise) of their use in aquaculture production systems and waste-water lagoons have been well described in the scientific literature. Bighead carp are considered to be, on the whole, beneficial where introduced. Intensive polycultures of fishes low in the food chain or combinations of these fishes with those higher in the food chain lead to increased yield increments relative to space and water resource requirements. We find the ecological risk too small to adequately assess.

*Predict benefits and risk to humans--In addition to providing food for human consumption at a low risk to the producer, bigheads enhance water quality in both aquaculture facilities and potable water supplies where plankton produces taste and odor problems. It is also a valuable organic fertilizer and can be processed into fish meal by-product. The economic value of this fish in the Illinois aquaculture industry has not been determined, but production sold to in-state and legal out-of-state markets could easily exceed a value of $10 million by the end of this century. Other than the potential introduction of disease or parasites to humans, we cannot, at this time, identify any other risk to the human population.

Decision Point #3

-Would the exotic species have major adverse ecological impacts? NO, as best as we can determine.

-Would the exotic species potentially be hazardous to humans? NO

Proceed to Level of Review IV

Level of Review IV

*Conduct a detailed literature review to develop an FAO Species Synopsis

-An FAO Species Synopsis for bighead carp was published by the U S Fish and Wildlife Service in **September 1988**

Decision Point #4
-Was data base adequate to develop a complete species synopsis for the bighead carp? YES
-Does data base indicate desirability for introduction of bighead carp to Illinois? YES

Decision Point #5
-Based on all available information, do the benefits of bighead carp introduction outweigh the risks? YES

After careful review of the literature with subsequent analysis of the data base in the FAO Synopsis, we strongly believe and support the contention that;

*importation, culture, and sale of bighead carp by private sector aquaculturists in Illinois will effect minimal to no risk to the state's aquatic environment, and

*any opportunity for in-state or out-of-state sales of bighead carp culture in Illinois will be an additional boost to the Illinois aquaculture industry and to the State's economy.

PETER MOYLE'S REPONSE

Thank you for giving me the opportunity to review the proposal to introduce bighead carp, Hypophthalmichthys nobilis into Illinois for aquaculture purposes. I would urge you to deny the application at least until a more thorough analysis is completed either by someone from your own agency or by an independent party. My reasons for this are as follows:

1. I appreciate the efforts of Mr. Waite to follow the protocol of Kohler and Stanley (1982), but he really only pays lip service to it. Wherever there is adequate information lacking at one of the decision-making steps, he decided in favor of the bighead carp.

2. You must assume bighead carp will escape from aquaculture operations, despite assurance to the contrary. If the fish is widely raised, sooner or later an unexpected flood will wash out rearing ponds, someone with their own ideas of fisheries management will illegally introduce them into natural waterways, or some other deliberate or accidental introduction will occur. If our experience with grass carp is any guide, this means that sooner or later wild, reproducing populations of bighead carp will become established.

3. In light of the above, appproval should not be given unless all other states that might have the fish or fisheries affected by the establishment of bighead carp in the Mississippi drainage approve it as well.

4. The position statement downplays too much the potential effects of the spread of new parasites and diseases. Who could have predicted, for example, that Asiatic tapeworm brought in with grass carp would contribute to the endangerment of woundfish in the Virgin River, Utah? According to a recent paper by J. Deacon (in Fisheries), the tapeworm was first picked up by red shiners being raised for bait. When shiners were brought by bait fisherman to the Colorado River, they passed the tapeworm on to the native woundfin, apparently weakening the wouldfin's ability to compete with other species. If the bighead carp is approved for introduction, all fish should be thoroughly quarantined first.

LAKE VICTORIA NILE PERCH: DESTROYER OR PROVIDER??

The scientific community has overwhelmingly reported that the introduction of the Nile perch (Lates niloticus) in Lake Victoria has catastrophically affected dozens or even hundreds of haplochromine species; many of which supposedly faced imminent extinction if nothing was done to save them from this "monster fish." During the past few months at least two articles (excerpts reprinted below) have appeared suggesting a disproportionate amount of the blame for the declining haplochromine stocks has been erroneously attributed to the Nile perch. Destroyer or Saint?? We don't know yet, but it appears this fish may be neither but something in-between.

An overriding question is 'When are exaggerated claims of catastrophic or beneficial effects of introduced species justified?' The information given below is not so much for the specifics involved, rather it illustrates the all too common scenario of exaggerated claims (positive or negative) that so often accompany species introductions. Another example of this scenario is highlighted in a recent article titled 'Killer bee: the case for the defence' (C. Joyce, New Scientist, 11 February 1989 p.36) which suggests the widely publicized claims of the catastrophic effects of this introduction are also exaggerated.

There are valid needs for philosophizing and even sermonizing on issues involving species introductions, but maybe it is time to report these separately from observations based in scientific objectivity. The issues at hand and our own credibility seem too important to do otherwise. For more on the Nile perch, see IFS Newsletters 7(2):3-4, 7(3):8-11 and 8(1):13.

--Editor

MONSTER FISH MAY BE INNOCENT OF ECOLOGICAL CRIMES

Nile perch might not be guilty of all the crimes they have been accused of in recent years. The fish was introduced into Lake Victoria 20 years ago, probably for sport, and has come to dominate the lake.

Although people argue about how the voracious Nile perch came to be there, most believe that it has been an ecological disaster, eating most of the smaller native fish (New Scientist, 27 August 1987, p 50).

Scientists from the Natural History Museum in London and biologists from Tanzania and Kenya now have evidence that the perch is not wholly responsible for the rapid decline of the local fisheries.

Biologists are interested in Lake Victoria because it is a centre for the evolution of a group of small fish called haplochromines. About 200 species of these brightly coloured fish are found in the lake and nowhere else. These fish and other small fish, such as tilapia, form the basis of subsistence fisheries and of some commercial fisheries. Their survival is vital to local people. The number of fish has fallen dramatically in recent years. Two years ago, a team from the Natural History Museum, the Haplochromis Ecology Survey Team from Leiden, in the Netherlands, and local fisheries biologists surveyed a large area of the Tanzanian part of the lake. Unexpectedly, they found large numbers of haplochromines. This year a team of biologists led by James Maikeweki from the National Museums of Kenya and Keith Harrison from the Natural History Museum surveyed the Kenyan part of the Lake. The survey included an area called the Winam Gulf, reportedly cleared of haplochromines.

In most places the biologist found few haplochromines and many Nile perch. But in some places they caught hundreds of specimens of many species, not only haplochromines but also other species believed to be in decline. Nile perch were present in the same catches, often in large numbers. The areas that are rich in haplochromines were all reserves, where fishing is banned. Close by, where fishing is allowed, the fish were rare.

The evidence suggests that overfishing with fine-meshed nets is partly to blame for the "ecological disaster" in Lake Victoria. Rather than concentrate on the problem of the perch, the biologists suggest that it would be better to collect more reliable data on the fish populations of the lake in order to make sensible decisions on how best to save the haplochromines.

New Scientist 119(1622):34,
21 July 1988

THE CONTROVERSY OVER NILE PERCH, LATES NILOTICUS, IN LAKE VICTORIA, EAST AFRICA

T.O. Acere

In 1959 and from 1962, Nile perch were intentionally introduced into Lake Victoria amid controversy which has continued to the present. The 1950s also saw mass introductions of exotic tilapias (Tilapia zillii,

T. rendalli, Oreochromis niloticus an O. leucostictus) into Lake Victoria and other lakes, dams, valley tanks and ponds in Uganada. The objective of the introductions was to increase fish production for the increasing human population after the collapse of the fisheries for the endemic tilapias O. esculentus and O. variabilis and anadromous species, especially Labeo victorianus.

Nile perch is endemic in Lake Tchad (West Africa), Lakes Turkana (Kenya) and Albert (Unganda), and the River Nile starting from below the Murchison Falls (Uganda). In East Africa Nile perch occurs together with O. niloticus and other very abundant fish. Other species of Lates occur in Lake Tanganyika which is also very rich in fish species. Lates were also present in the Lake Victoria basin during the Miocene period (about 25 million years ago) and persisted until comparatively recent times in Lake Edward (Uganda). The genus failed to recolonize Lakes Edwards and Victoria due to the barriers offered by the Semilike rapids and the Murchison Falls. The new stocking of Nile perch into Lake Victoria was a reintroduction

Nile perch is an opportunistic feeder and participates in almost all the trophic levels above the primary producers. It is not "voracious" as some eminent scientists have painted it in both the scientific and popular western media. Rather it eats as much as would be expected from a fish of its size and rather less than more active fishes, such as tuna.

The purpose of this discourse is to explain the events which took place concerning the fisheries of Lake Victoria before and after the stocking of Nile perch and O. niloticus. This, it is hoped, will enable the reader to understand and fully participate intellectually in the Nile perch controversy.

Development of the Fisheries

Fishing has always been an important occupation of the people around Lake Victoria. Before the introduction of the cotton gill nets in 1905, hooks and lines, harpoons, lances, fences and basket traps were the main fishing gears used. The fishing pressure was determined by the subsistence needs of the people living around the shores. The main fish species caught include tilapias (O. esculentus and O. variabilis), mormyrids, catfish, anadromous cyprinids (Labeo victorianus and Barbus spp.) and lungfish.

The introduction of cotton gill nets in 1905 and flax gill nets during 1916 stimulated higher catch rates and created a fishery base primarily on O. esculentus. With the completion of the Mombasa-Kisumu railway in the early 1900s the demand for fish was very high, leading to an increased number of gill nets being used. This uncontrolled entry into the fisheries confined to the shallow inshore waters soon resulted in decline in catches per unit effort, particularly in the Kenya part of the lake. The average catch for the herviborous O. esculentus per standard 45 m net per day was about 100 fish in 1905, 30 in 1921 and

7.8 in 1928. By the 1920s the existence of a problem was realized and Mr. Michael Graham of Lowestoft carried out a survey in 1927-1928 to establish the status of the fishery.

Consequently certain measures were instituted: (1) By 1933 the gill net had a manadatory stretched mesh size of no less than 127 mm to avoid catching immature O. esculentus. Beach seines were retained. (2) The collection of catch statistics was started. (3) In 1947 the Lake Victoria Fisheries Service was created, with authority for complete control of fishing power. The East African Fisheries Research Organization (EAFRO) was formed in the same year.

As fishing effort increased during the late 1940s, the catch per net further dropped and the average size of the marketable fish was significantly reduced. The absence of a big price differential between large and small fish encouraged the use of undersized gill nets to maximize the catch in numbers.

The average catch per net fell from 2.7 to 1.6 fish in 1954. By 1957-1958 the catch rate of O. esculentus per net in Uganda (Jinja) of mesh sizes 81, 91, 96, 102, 112 and 123 mm was 6.4, 8.4, 5.5, 2.4, 1.7 and 0.7 fish, respectively. The biological overfishing of the inshore fish stocks of Lake Victoria had the effect of forcing fishermen to extend their geographical range. These experiences show that biological overfishing is a real danger to fisheries based upon mouth-brooding tilapias and anadromous species. By the time the catch per net with smaller meshes had declined to an uneconomic low level, the stocks of O. esculentus, O. variabilis, and other endemic species had been seriously depleted.

Despite the decline, an "expert" from an international organization, after a three-day visit in 1957, provided a grossly erroneous and misleading estimate of maximum sustainable yield of 1,800 t for the above stocks. This estimate was used to support expenditure of several thousands of pounds sterling on the Jinja market. This market was threatening to become a white elephant because of poor catches. The introduction of O. niloticus and Lates niloticus saved Jinja Fish Landing and others on the shores of Lake Victoria from becoming monuments of mismanagement.

Management Predictions

The effect of the 1956-1957 change from 127 to 102 mm and smaller mesh nets was that all the noncichlid species i.e., Bagrus, Clarias, Barbus and Protopterus, give poorer yields.

In the early 1960s, gill nets below 90-mm mesh came into use for the tilapias although some noncichlids had disappeared from the catches because of the previous use of small mesh gill nets and traps at the mouths of rivers. By the late 1960s, 38 to 46-mm mesh gill nets were being used to harvest smaller fish species such as the haplochromine cichlids and Synodontis which previously had been unexploited. The

beach seines, which harvest haplochromines and large numbers of brooding and juvenile tilapias and juvenile Nile perch, have also been spreading around the lake since then. The mosquito seine (13-mm mesh), which also captures juvenile haplochromines, has recently become popular in the more heavily exploited parts of Lake Victoria in Kenyan and Tanzanian waters. Between 1972 and 1973, O. esculentus began declining in Kenyan and Tanzanian waters of Lake Victoria, and there was a slow but equally consistent increase in large predators such as Bagrus and Clarias. This was long before the introduced Nile perch had established itself. By 1981 the haplochromines had disappeared from Kenyan waters, while Clarias, Bagrus and Protopterus were rare.

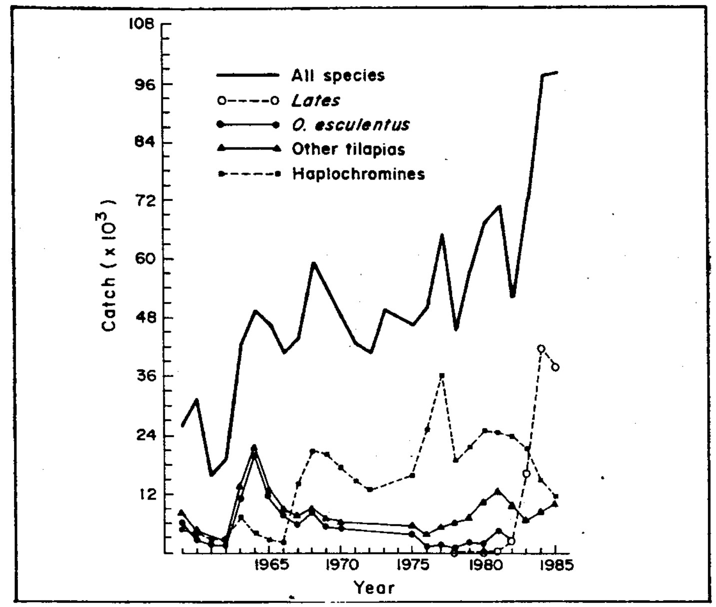

Fig. 1. Annual catches in Tanzanian waters of Lake Victoria, 1959-1985.

Trawl nets experimentally introduced in the late 1960s and commercially used since the 1970s have completely destroyed haplochromines in the Nyanza (Kenya) and Mwanza (Tanzania) waters.

Finally, even the presently booming fisheries of Lates niloticus and Oreochromis niloticus are doomed if the use of small mesh gears including trawling and beach seining continues unabated. At present the two species contribute 70-100% of the total tonnage landed in various areas of Lake Victoria (and in nearby Lake Kyoga their catch is almost 100%).

The Controversy

Although overfishing is clearly the major cause for the decline of the haplochromines of Lake Victoria, a number of eminent taxonomists and other naturalists have attributed this decline to the piscivorous habits of adult Nile perch.

The anti-Nile perch campaign is ill-conceived. In the 1960s there were sharply worded exchanges based on practical experiences from scientific observations on the part of the proponents (fisheries biologists) against purely academic speculations advanced by some eminent scientists. The anti-Nile perch group dismissed the results of the UNDP/EAFRO stock assessment trawl survey of Lake Victoria, 1968-1971. The UNDP/EAFRO trawl survey revealed the existence of about 600,000 t of ichthyobiomass, of which 80% was composed of haplochromines. These results were called as a waste of time and money. In the mid-1980s, the controversy erupted again.

However, the emergence of the fisheries composed of exotic O. niloticus, which grows to over 3 kg and Nile perch, which can grow to 200 cm is welcome to both urban and rural East Africans. Nile perch can be fried in its own content of fat, saving cooking oil which costs no less US $2.00/1. Nile perch costs less than US $1.00/kg on the shores of Lake Victoria, whereas beef, mutton, pork, chicken and poultry products cost US $3-5.00/kg.

The haplochromines are small bony fishes which were unpopular with the consumers. They were being used for fish meal for poultry production and occasionally they were used medicinally against measles. One should acknowledge, though, that they are unique, endemic species and that they are threatened by overfishing, particularly with the introduction of commercial trawling in Kenyan and Tanzanian waters of the Lake. Even Ugandan areas, e.g., the Jinja area, which were intensively trawled, experienced severe declines of haplochromines.

Although the eminent scientists did not pinpoint directly the cause for the decline of the haplochromines, it is the concern of every scientist to see to it that no species are eliminated at all from the face of the earth. Fisheries scientists should be very much in the forefront to conserve aquatic resources for posterity.

> Reprinted excerpts from: ACERE, T.O. 1988. The controversy over Nile perch, Lates niloticus, in Lake Victoria, East Africa. Naga, The ICLARM Quarterly 11(4):3-5.

INTRODUCED AQUATIC ORGANISMS JOURNAL??

Bill Devick (Hawaii Department of Land and Natural Resources) writes "There seems to be a need for an international journal dedicated to introduced aquatic organisms that relate to fisheries. Such material

now may appear in a slew of unrelated and often obscure places, if it is published at all. It would be nice if the IFS Newsletter could fill the vacuum, but it obviously can not be expanded to such an extent. As an alternative, perhaps each issue of the Newsletter could include an updated and reasonably comprehensive reference listing including relevant books, scientific publications, technical reports, and significant popular articles. Participation of a good librarian could assure inclusion of major books and scientific articles. Other listings would be largely dependent upon IFS member participation. And it would still mean a lot of work."

What do you think about this idea? At the very least, we could periodically include comprehensive listings of significant publications on any germane topic that is provided your editor.

PEOPLE ON THE MOVE

Immediate Past-President Nick Parker has recently taken over the new Texas Cooperative Fish and Wildlife Unit at Texas Tech University. Nick's new address is given at the end of this Newsletter. Congratulations Nick!

CARL SULLIVAN RECUPERATING

This note from Paul Brouha, Deputy Director AFS, is certainly of concern to all of us: "Carl Sullivan is recovering well from major surgery today [January 26, 1989] after undergoing a six-hour operation to remove a large cancerous tumor from his stomach. During the six-hour procedure surgeons removed a honeydew mellon-sized lieomyosarcoma (cancer of the stomach's muscle lining) involving 80% of Sully's stomach. They also removed one half of his pancreas and his spleen. His sons Pete and Mike stopped by after the surgery yesterday and reported his vital signs were strong as he emerged from surgery. Assuming there are no complications, Sully can expect to emerge from post operative recovery tomorrow and to return home in three weeks. Doctors expect he will be able to return to a limited work schedule after a convalescence at home of six weeks.

"Many of you know that Sully had not been feeling well for several months. Doctors struggled to diagnose his ailment but it was not until the 13th of January after a CAT scan that the large tumor was found. He approached the surgery in an excellent frame of mind and is now conscious, coherent and in good spirits.

"He would appreciate your thoughts and prayers. Cards, letters and flowers may be sent to: