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UNITED STATES GOVERNMENT

# *Memorandum*

BUREAU OF SPORT FISHERIES & WILDLIFE
Region 2, Albuquerque, New Mexico 87103

TO : All Project Leaders
Region 2

DATE: September 18, 1972

FROM : Regional Director
Albuquerque, New Mexico

SUBJECT: White Amur or Grass Carp

Very recently we have all read, through the national news media, the wonders of the white amur or grass carp. Its ability to devour tremendous amounts of aquatic weeds seems to hold the answer to a biological control of certain aquatic nuisance plants. This has resulted in considerable pressure being brought on the Bureau for white amur or grass carp stocks. To assist you in answering such requests for or inquiries about this species, Acting Director F. Victor Schmidt has provided the following information and policy statement:

> "The white amur or grass carp has recently had a tremendous surge in popularity. The fact that this fish eats aquatic weeds has caused many people to abandon reasonable caution in their enthusiasm for a new approach to aquatic weed control. This fish does eat certain kinds of aquatic plants and under some conditions may essentially eliminate them. Some important duck foods are among those readily consumed by the grass carp.
>
> As a Bureau, we are interested in developing biological controls. At the same time, however, we must act in a responsible manner. There is much research yet to be done before the Bureau uses this fish in an operational manner or recommends its use outside the Bureau. There are many things we do not know about this fish, including the extent of competition with game fish and other aquatic animals, especially in the absence of aquatic plants. Exotics always have a potential of doing the unexpected, and this necessitates careful research before the fish are released. Although it is not known to have spawned naturally in the United States, it is probable that they will do so when they get in the right river environment at the right time.
>
> Even though the fish are now readily available from several sources, I want to be sure all employees recognize the necessity to act in a responsible manner with regard to this fish. For this reason, no grass carp will be stocked by any Bureau employee or in any Bureau facility unless the proposed use is part of the Bureau's research effort and is endorsed by the Assistant Director for Research."

The white amur may eventually prove to be useful and controllable, but at present state of knowledge it is certainly not worth the gamble. We must

all adhere strictly to this policy and must discourage others from any introductions of this species until further research and information becomes available.

W O Nelson Jr

# ARKANSAS' EVALUATION OF THE DESIRABILITY OF INTRODUCING THE WHITE AMUR (CTENOPHARYNGODON IDELLA, VAL.) FOR CONTROL OF AQUATIC WEEDS[1/]

by

William M. Bailey
Arkansas Game and Fish Commission
Little Rock, Arkansas
September, 1972

The white amur is receiving a considerable amount of publicity, both good and bad. The State of Arkansas has been involved in the controversy because of its decision to utilize this fish in its public fishing waters to control noxious aquatic weeds.

Certainly a decision of this magnitude required considerable study - of the fish and its adaptations; its habits and requirements for feeding and spawning; and of the literature, to compare our observations with those of others and to determine the past performance of this fish. The final decision was based on our observations since the first importation by the Bureau of Sport Fisheries and Wildlife in 1963, reports by other agencies in the United States, namely; the Bureau of Sport Fisheries and Wildlife in Arkansas, Georgia, Alabama and Washington, D.C.; the U. S. Department of Agriculture in Florida; Auburn University; reports from Arizona and Illinois; and on the research by workers in Malaysia, India, Taiwan, Japan, China, England, several areas of Russia, Poland, Czechoslovakia, Hungary and others. The true record of other introductions, the white amur's relationship to the common carp, and the distribution of the white amur in this country, were also considered.

After determining that a serious aquatic weed problem does exist in many areas, causing difficulties in fishing and fish management, navigation and other aspects of water use, the different methods of weed control were considered and biological control was deemed most feasible. Mechanical controls are impractical to use on a large scale and chemical control, although sometimes effective, are usually either only partly or temporarily effective and/or very expensive -

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1/ This report is a summary of the original document of the same title which may be obtained by writing the author, c/o Joe Hogan State Fish Hatchery, Post Office Box 178, Lonoke, Arkansas 72086.

and their effects on the environment are generally unknown, but in some cases, harmful.

Chemicals are now being used indiscriminately and, in some cases, illegally at a rather alarming rate, even though no herbicide has a residue tolerance limit established in water, fish or shellfish.

The white amur has proven itself an effective control of many submerged weeds. It has controlled weeds for the Arkansas Game and Fish Commission on all three state hatcheries for several years. After observing its effects in a hundred or so ponds and some of our state-owned lakes, there is no longer any question that this is an effective biological weed control agent when properly used. No researcher has found that this fish wouldn't control submerged weeds.

The possible effects on our environment have been considered and at the worst are far better than the possible effects of some of the chemicals which are now being used in its stead. The primary reasons that exotics become pests are lack of controls and/or overproduction, and environmental or habitat degradation. The white amur's spawning ability and requirements, and its past performance, insure that it will be a very inefficient spawner, especially in short rivers or areas where dams have reduced the current below the required level for proper incubation of the eggs. This fish spawns in strong currents (1 to 5 feet per sec.) after a quick rise in the water level. Eggs must be carried by the current for several hours - then fry too need the current to hold them off the bottom and in motion to escape silt and predation. These things, along with temperature requirements, serve to limit the areas where this fish can spawn, and the vulnerability of the fry limits survival. Their desirability as a food fish assures harvest, so the possibility of overproduction is unlikely.

Their effects on the habitat are essentially the effects caused by weed removal. The competition for food with other fishes is insignificant, in fact, production of other fishes sometimes increases when weeds are removed by this herbivorous fish. Since stocking rates are controlled and extra fish can be removed by sport or commercial tackle or with fish toxicants, over control of weeds should not be a problem for those who want to keep their aquatic plants. The white amur is not adapted at all to a rooting habit and does <u>not</u> stir up or roil the water, causing a muddy condition. The habitat is generally improved, in our opinion, by the presence of this fish.

For those whose primary concern is that the white amur is in the same family as the common carp - this point too has been considered and the differences are so dramatic as to render

that particular fear absurd. The traits which give the common carp the ability to become a pest in some areas are, primarily: its ability to spawn anywhere, its adaptations to muddy water (and for rooting which muddies the water), its general competition with our native fishes, and its low desirability as a food fish.

A general comparison of the white amur and the common carp is made here with respect to those traits.

| | *Cyprinus carpio* | *Ctenopharyngodon idella* |
|---|---|---|
| Related to reproduction: | | |
| Eggs | Heavy and adhesive (Suitable for still or running water) | Semi-buoyant and not adhesive (Suitable only for flowing water) |
| | More highly developed and more able to hide and escape predation and to swim above depositing silt. | Hatch very immature and extremely vulnerable to predation and silt. Current still needed for survival after hatch. |
| Related to feeding: | | |
| Adaptation of | | |
| Pharyngeal teeth | Crushing or grinding | Cutting and shredding |
| Primary food | Insects and benthic organisms | Macrophytes |
| Adaptation of | | |
| Mouth | Mouth subterminal and lips protractile (for feeding and rooting the bottom) | Mouth terminal, not projectable (adapted to open water feeding) |
| | Barbels present (adapted to muddy water) | Barbels absent (not adapted to muddy water) |
| Desirability of flesh as food: | | |
| | Flesh loose, oily with dark areas | Flesh firm, white, not oily |

It is important to note that if problems arise the white amur is much easier to control with fish toxicants, such as rotenone, than is the common carp. In fact, aquarium tests have shown that it can be controlled with a very light concentration - about one-tenth that required for a kill of all species.

The true record of the introduction of new fish into non-native areas hasn't been bad. Of 25 or so exotic species which have become established by reproducing, only one has become a widespread pest. Tens of millions of live exotic fishes are brought into this country annually by fish dealers and no major disasters have occurred. Non-native fishes are transplanted into new areas each year to occupy a niche or utilize a part of the biota not being fully utilized by the natives, and it is working. The white amur also has a place in our waters.

Finally, the white amur has already been introduced into open waters in this country. It was found in 1970 and 1971 in the White River and the Mississippi River, which, for better or worse, makes further delay of the use of this effective and desirable "tool" futile.

The Arkansas Game and Fish Commission has decided to use the white amur for its intended purpose, and has stocked them in many lakes in all areas of the state. While the carp controversy rages, and thousands of tons of unnecessary chemicals are dumped into our waters, the white amur is slowly doing its job in the public waters of Arkansas. Nature has provided a valuable "tool" to solve another problem if only "technical man" is able to recognize it.

WMB:bp
9/8/72

# AN EVALUATION OF THE ADVISABILITY OF THE RELEASE OF THE GRASS CARP, *CTENOPHARYNGODON IDELLA*, INTO THE NATURAL WATERS OF THE UNITED STATES

David W. Greenfield

Department of Biological Sciences
Northern Illinois University
De Kalb, Illinois 60115

## INTRODUCTION

The grass carp, *Ctenopharyngodon idella* Valenciennes, has recently received considerable attention from various state and federal agencies as a potential method of controlling noxious aquatic plants. This heightened interest necessitates a thorough evaluation of the probable impact of the introduction of this species on the native fish fauna of the United States.

The grass carp, also known as the white amur or Waan Ue, is native to the rivers, lakes and ponds of Siberia (Amur Region), Manchuria and China, southward to the Chu River, South China. It has been introduced for pond culture into Formosa, Malaysia, Japan, Viet Nam, Thailand, Hong Kong, Ceylon, and India as well as into the U.S.A., Great Britain, Israel, eastern Europe, Germany and Holland (Cross, 1969; Kuronuma, pers. comm.; Lin, 1935; and Stevenson, 1965).

In the United States the grass carp was first introduced by the Bureau of Sport Fisheries and Wildlife to the Fish Farming Experimental Station, Stuttgart, Arkansas in November, 1963. The

grass carp has been introduced into five state-owned fishing lakes in Alabama, cultured at the Marion Fish Hatchery, Alabama, maintained at Auburn University, Alabama, planted into an irrigation pond at Tucson, Arizona, kept in artificial ponds in Arkansas, and at Oregon State University. Three grass carp, weighing about 20 pounds each (4 years old) have already been taken in the Mississippi River, two from as far north as Southern Illinois.

## CONTROL OF AQUATIC VEGETATION

Nair (1968) cites numerous references attesting to the ability of the grass carp to control the growth of aquatic plants. Cross (1969) presents a table listing the various plants eaten by the grass carp, in the approximate order of their preference. Avault (1965) presented data on its herbivorous habit in ten experimental pools, which had each been planted with 12 species of aquatic plants. Each pool was stocked with a single grass carp, 12 to 16 inches long, equalling 685/acre. Within two to three weeks complete control was obtained. Stevenson (1965) reports that six fish averaging 908 grams were placed in a 0.25 acre pond (24/acre) containing *Chara, Najas, Eleocharis,* and *Polygonum.* In two months the aquatic plants were reduced but not eliminated, but the fish were also supplied with commercial feed. In a second pond (0.1 acre), containing *Chara, Najas,* and *Anacharis,* three fish, approximately 1,270 grams each were introduced. Two months later the *Chara* and *Najas* had been removed but the *Anacharis* remained and an abundant growth of

*Spirogyra* was present. Commercial feed was also supplied to this pond. McConnell (pers. comm.) reported that forty 2 inch fingerlings were introduced in a two acre pond on a Tucson, Arizona golf course, and that "after the first year they were very effective in keeping the pond free of undesirable weed growth". McConnell also reported that a single grass carp was transferred to a 1/2 acre pond which was weed choked, and that although it did not completely control the weeds, its grazing caused a noticeable reduction in weed density.

It appears that if stocked at fairly high concentrations, the grass carp can be of considerable value in reducing aquatic vegetation.

## FEEDING HABITS

All of the above mentioned studies have been conducted with adult or subadult individuals, in artificial ponds or lakes. Lin (1935) in a study conducted at the West River in the interior of Kwangsi Province, China, reports "Its omnivourous feeding habits are well known. The Waan Ue eats grass, leaves of trees, and water plants as well as small fish, earthworms, silkworm pupae, beef, insects and even decayed cloth and shoes". Hora and Pillay (1962) reported that the fish is an omnivore eating chopped fish, flesh of freshwater mussels, and silkworm pupae along with aquatic vegetation. Stevenson (1965) reports that fingerlings fed heavily on *Daphnia* which was suspended, and that chopped earthworms

were eaten voraciously in large quantities. Chironomid larvae were also highly preferred. Stevenson (1965) further states that in one pond the fish fed on zooplankton to the exclusion of algae and commercial feed. Cross (1969) reported that in his laboratory, grass carp about nine inches in length, ate *Daphnia*, tubifex worms and *Asellus* as well as vegetation. Nikolskii (1954 and 1956) reports that the young of the grass carp feed on crustaceans, rotifers, and chironomid larvae. It has been suggested by Stevenson (1965) that in pond situations the grass carp may be forced to feed exclusively on aquatic vegetation and thus any preference for other foods would not be seen.

Recent studies at Auburn University by R. H. Kilgen and R. O. Smitherman (pers. comm. and 1971) have dealt with the feeding habits of the grass carp in pond situations where other species of game fish were present. A comparison of the stomach contents of the grass carp indicated that 84% of its food consisted of macrophytes, 9% insects, mostly chironomid larvae, and 7% Purina Trout Chow. The largemouth bass, spotted bass, redeye bass, Israeli carp and channel catfish in the pond fed mainly on insects. The presence of high percentages of insects in the stomachs of the species other than the grass carp indicates that animal food was available but that the grass carp fed mainly on plant material. Tang (1970) has indicated that in the absence of competition or when the supply of macrophytes is low the grass carp will switch to food items other than aquatic plants.

## DIGESTION

Hickling (1966) reported that the digestive tract of the grass carp is extremely short for a herbivorous fish and that at a temperature of 28° to 30° C, the food passes completely through the fish in less than 8 hours. Digestion is incomplete, with about 1/2 of the food material passing through undigested. Hickling (1966) states that this undigested food can support, directly or indirectly, a large biomass of other species of fish. Stroganov (1963) reported that the feces of the grass carp promotes vigorous growth of plankton. Due to the incomplete digestion, the grass carp must consume large quantities of food and this, of course, is the reason for its usefulness in controlling aquatic vegetation.

## REPRODUCTION

Lin (1935) and Kuronuma (pers. comm.) reported that spawning takes place in the center of large rivers with currents of 12,000 to 20,000 feet/hour usually just below extensive rapids. Nikolskii (1956) states that a current flow of between two and five feet per second is required. The temperatures required for spawning are 26-30° C according to Lin (1935) and above 20° C, Nikolskii (1956). In addition to these requirements, spawning takes place after a sudden rise in the river, usually after heavy rains. Lin (1935) stated that a rise in excess of 4 feet within a 12 hour period is necessary for spawning to occur. Presumably, spawning during

periods of high turbidity reduces predation on the semi-pelagic eggs. This species undergoes a spawning migration, usually in large shoals, with spawning occurring from April to mid-August. Most of the spawning in the West River, China, occurs from the end of May to mid-June.

Lin (1935) reported that a 16 pound female contained 100,000 eggs, but felt that all of the eggs were not spawned at one time. The eggs are semi-pelagic, floating downstream in the mid-layers of the water (Kuronuma, pers. comm.). Lin (1935) reported that hatching takes place 34 hours after fertilization, while Tang, Hwang and Lin (1963) gave a figure of 24 to 30 hours at 25°C. Within a short time the larvae are swimming actively, and begin feeding on zooplankton and to a lesser extent phytoplankton.

Generally, grass carp have not reproduced in pond situations outside their natural habitat. However, this species has been reported to have spawned in Japan (Anon., 1961) and in Taiwan (Tang, 1960). Spawning has been induced in pond situations by injections of fish pituitary extracts (Tang et al., 1963 and Alikunhi, Sukumaran and Parameswaran, 1963).

## AGE AND GROWTH

Lin (1935) found that most of the grass carp in the West River, China, were about four years old and that none of the mature fish were less than three. Females were larger than

males, reaching a length of about three feet. Cross (1969) reported that the fish takes between five and nine years to become sexually mature. Stevenson (1965) presented data showing a weight of 4 grams and a length of 8 cm at 6 months, 372 gm and 28 cm at 12 months and 1,816 gm and 50 cm at 18 months. He also indicated the following age at first maturity for various areas.

| | | |
|---|---|---|
| Russia | 8-10 years | 2.7-3.8 kilograms |
| S. China | 4 | 6.0 |
| Israel | 5-8 | 8.0-10.0 |
| Malaysia | 10-14 months | 2.0-5.0 |

Kuronuma (pers. comm.) indicated that the rate of growth of the grass carp is two to three times that of the common carp, *Cyprinus carpio*, under similar environmental conditions. The grass carp attains the size of 1.5 meter in length in river waters within five or six years. Hooper (pers. comm.) stated that in Alabama lakes grass carp stocked as two year olds grew up to 6 pounds the first year.

## PHYSIOLOGICAL REQUIREMENTS

Cross (1969) summarized the physiological requirements of the grass carp as follows: "It is able to withstand a wide range of water temperatures from 0 to 35°C (Stevenson, 1965), can tolerate salinities as high as 10,000 p.p.m. (Doroshev, 1963) and can withstand oxygen concentrations as low as 0.5 p.p.m.

(Yeh, 1959)." Stevenson (1965) noted that in one of his experimental ponds, in which the temperature fell to 0°C and a heavy ice cover formed which lasted five weeks, the grass carp showed no ill effects.

## INTERACTIONS WITH OTHER SPECIES

Kuronuma's (pers. comm.) studies have shown that the production of *Carassius auratus* and small shrimp was not affected by the existence of grass carp in farm ponds in Japan. McConnell (pers. comm.) found that grass carp did not noticeably interfere with a November to April put and take fishery in Arizona. The trout grew well despite the presence of an estimated 300 lbs./acre of grass carp. He has also stated that "During every spring in which grass carp were present in the pond we introduced brood stock of *Tilapia zillii*. Extremely dense populations of *T. zillii* were always produced by the following winter. Apparently there was no significant negative interaction between these species". Nakamura et al. (1954) found that in Japan the addition of the grass carp to ponds did not interfere with production of other fish species.

Kilgen and Smitherman (1971) in analyzing the food habits of grass carp in combination with largemouth bass, spotted bass, redeye bass, Israeli carp and channel catfish found that the overlap in food items was relatively little. Kilgen and Smitherman (pers. comm.) evaluated the growth rates of channel catfish and striped bass when stocked with grass carp at rates of 40 to 80

per acre and found no detrimental effects when compared with control ponds. Smitherman (pers. comm.) has evaluated the effects of grass carp (20 or 40/acre) on largemouth bass-bluegill, largemouth bass-bluegill-shad and fathead minnow-walleye-bluegill populations. The survival of walleye, threadfin shad and fathead minnows was erratic in the experimental ponds. The presence of grass carp at either 20 or 40 fish per acre did not greatly affect survival of fingerling bluegill or largemouth bass. Considering growth rates, comparing ponds with no grass carp with those containing grass carp at a rate of 40/acre, Smitherman found that the bass-bluegill in the control averaged 159.73 lb./acre, while in the ponds with the grass carp the weight was 119.15 lb./acre. This could be interpreted as a competitive effect on the growth or reproduction of the bass and bluegill, but Smitherman feels this is the result of greater survival of young bluegill in the ponds where the vegetative cover had not been removed by the grass carp.

## ADVANTAGES OF THE RELEASE OF THE GRASS CARP

The grass carp, when stocked at high enough densities, may serve as an effective biological method for the control of noxious aquatic plants. The presence of an effective biological control would eliminate the necessity of utilizing chemical controls and reduce the potential of environmental contamination. The Alabama State Conservation Department Hatchery at Sartaboga, Alabama has experienced an increased fingerling bluegill production

when using grass carp versus chemicals for weed control (Hooper, pers. comm.). In terms of economics, the use of a biological control should be less costly than the use of chemical or mechanical clearing. However, if hatchery rearing and pituitary injections are necessary to maintain the species, the cost would be increased.

Cross (1969) reported that in the commercial fish farms of eastern Europe, grass carp are reared primarily as a food and only secondarily as a weed clearing agent. He also reported that he found the flesh to be very pleasant. Hooper (pers. comm.) has indicated that the fishermen in Alabama have found the grass carp to be an excellent sport fish and to have outstanding eating qualities. Kuronuma (pers. comm.) had the following comments concerning its value as a sport and food fish, "... the grass carp will never be appreciated as food by American people; as to the value of grass carp as a game fish to American anglers, I can just say 'try it'". Smitherman (pers. comm.) has indicated that the flesh of the grass carp is bony, but excellent in flavor.

## DISADVANTAGES OF THE RELEASE OF THE GRASS CARP

The major question concerning the release of the grass carp into the natural waters of the United States is its impact on the native fish fauna. Concerning the adult grass carp, direct competition with native fish does not seem to be a major problem, for it does not appear to have an ecological counterpart among the native fishes. Also, it does coexist with a natural fish

community in Asian freshwaters. However, the ecosystem of Asian freshwaters may differ basically from that in the United States and the effects on the native fauna cannot be entirely predicted.

Indirect competition resulting from the removal of aquatic vegetation may, however, present a problem. Aquatic vegetation provides shelter and spawning areas for many native freshwater species and while the removal of aquatic vegetation from choked ponds may be desirable, the removal of such vegetation from rivers might reduce suitable spawning areas. The removal of aquatic plants by the grass carp in areas where food plants for water fowl have been established would pose a serious threat to water fowl management programs. Another consequence of the removal of aquatic vegetation concerns the fact that many species of fish utilize invertebrates which in turn are found on or around aquatic vegetation. In this respect competition could be direct. Smitherman (pers. comm.) in evaluating the grass carp for weed control stated "All ponds except F-22 to -24 were entirely free of weeds, with bottoms nearly as clean as those in newly constructed ponds ... The bottoms of F-25 to F-27 were even cleaner than ponds with the lower stocking rate of grass carp; evidently the fish dug into the soil to obtain roots of the midget sedge and other plants".

The young grass carp, as mentioned previously, would be in direct competition with the young of other species of native fish, since they feed mainly on invertebrates.

One other problem relates to the studies which have been conducted on digestive rates. Both Hickling (1966) and Stroganov (1963) have discussed the fact that the undigested food is returned to the water and can be utilized by other organisms. With this release of nutrients into the water, one could predict an increase in productivity perhaps leading to eutrophic conditions in some cases.

If reproduction were to occur in our larger rivers, it is possible that the grass carp might multiply incontrollably. One need only to look at the common carp, *Cyprinus carpio*, for a graphic example. It is probable that once established it might be extremely difficult to control.

## RECOMMENDATIONS

Several workers have already urged extreme caution in introducing the grass carp into our native waters: Stevenson (1965) "Although it would appear that the grass carp is an ideal fish to serve as a biological control for aquatic weeds, great care should be exercised and extensive studies made before the fish is released in natural waters"; Ling (1960) "But the possibility of having it become another major problem fish like the common carp is so great that unless the fish can become acceptable to the Americans its introduction should not be done hastily"; Cross (1969) " ... but tests will have to be performed here before any decision on the use of this fish can be taken"; Kuronuma (pers. comm.) "It may be recommended that careful

evaluation be made to weigh the effective uses of the species as a biological weed controller in fish ponds against the probable impact to the lives of native freshwater species in the United States".

I will add my voice to those who urge caution concerning further introductions. Perhaps in light of the recent captures in the Mississippi River, this caution is already too late. Smitherman (pers. comm.) reported that he and his colleagues at Auburn University are investigating the possibility of developing a mono-sex population which could be utilized for stocking in areas where the fish might escape to open waters. Investigations of the relationship between the addition of large amounts of undigested feces and eutrophication should also be made.

Studies at Auburn University have dealt extensively with the interactions between the grass carp and various game species, however, the majority of the fish fauna of the Mississippi drainage is not composed of these larger game species, but rather the suckers, minnows, darters, and other species which in the past have been considered as "trash species". With the welcomed new-found interest in environmental quality has come the realization that the native non-game fish species are a valuable resource which must be preserved. Studies involving competition of the young grass carp with the young of native non-game species should be performed as well as studies on the direct effects of the adults on non-game species.

It is my opinion that until these studies have been made, the risks are too great to allow importation and release of the grass carp.

ACKNOWLEDGMENTS

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## LITERATURE CITED


Alikunhi, K. H., K. K. Sukumaran and S. Parameswaran. 1963. Induced spawning of the Chinese carps, *Ctenopharyngodon idellus* (C. & V.) and *Hypophthalmichthys molitrix* (C. & V.) in ponds at Cuttack, India. Curr. Sci. 32: 103-106.

Anonymous. 1961. Report of the subcommittee on fishes. Proc. 10th Pacific Sci. Cong. Honolulu: 277.

Avault, J. W., Jr. 1965. Preliminary studies with grass carp for aquatic weed control. Progr. Fish Cult. 27: 207-209.

Cross, D. G. 1969. Aquatic weed control using grass carp. J. Fish Biol. (1): 27-30.

Doroshev, S. I. 1963. The survival of the white amur and tolstobik fry in Sea of Azov and Aral Sea water of varying salinity. In: Symp. Probl. Fish. Exploit. of Plant Eating Fishes in the Water Bodies of the U.S.S.R. Ashkhabad Acad. Sci. Turkmen U.S.S.R.

Hickling, C. F. 1966. On the feeding process in the white amur (*Ctenopharyngodon idella* Val.). J. Zool. (Lond.) 148: 408-419.

Hora, S. L. and T. V. R. Pillay. 1962. Handbook on fish culture in the Indo-Pacific region. FAO Fish. Biol. tech. Pap. 14: 203 pp.

Lin, S. Y. 1935. Life history of Waan Ue, *Ctenopharyngodon idellus* (C. & V.). Lingnan Sci. J. 14(1): 129-135.

Ling, S. W. 1960. Control of aquatic vegetation. In: Lectures presented at the Third International Inland Fisheries Training Centre conducted by the Government of Indonesia and the Food and Agriculture Organization of the United Nations with the cooperation of the Indo-Pacific Fisheries Council held at Bogor, Indonesia, 31 October - 10 December, 1955. Rome, FAO, 29 pp.

Nair, K. K. 1968. A preliminary bibliography of the grass carp *Ctenopharyngodon idella* Valenciennes. PAO Fisheries Circular no. 302.

Nakamura, K., *et al.* 1954. Fish production in seven farm ponds in Shioda plain, Nagano Prefecture with reference to natural limnological environment and artificial treatment. Bull. Freshwat. Fish. Res. Lab., Tokyo. 3(1): 79 pp.

Nikolskii, G. V. 1954. Special ichthyology. Translation 1961, Smithsonian Inst.

Nikolskii, G. V. 1956. Ryby basseina Amura (Fishes of the Amur Basin). Itogi Amurskoi Ikhtiologicheskoi Ekspeditsii 1945-1949. Moscow, Akademia Nauk SSSR: 551 pp.

Stevenson, J. H. 1965. Observations on grass carp in Arkansas. Progr. Fish Cult. 27: 203-206.

Stroganov, N. S. 1963. The food selectivity of the Amur fishes. Problems of the fisheries exploitation of plant-eating fishes in the water bodies of USSR. Trudy Akad. Nauk Turkmen SSR: 181-191.

Tang, Y. A. 1960. Reproduction of the Chinese carps, *Ctenopharyngodon idellus* and *Hypophthalmichthys molitrix* in a reservoir in Taiwan. Jap. J. Icthyol. 8: 1-2.

Tang, Y. A. 1970. Evaluation of balance between fishes and available fish foods in multispecies fish culture ponds in Taiwan. Trans. Amer. Fish. Soc. 99(4): 708-718.

Tang, Y. A., Y. W. Hwang and C. K. Liu. 1963. Preliminary report of injection of pituitary hormone to induce spawning of Chinese carps. Occ. Pap. Indo-Pacific Fish. Coun. 63(14): 1-7.

Yeh, Y. T. 1959. A preliminary report on the oxygen consumption, energy requirement, asphyxiation point and respiratory quotient of fish fry and young fish. Acta Zool. Sin. 11: 117-137.

MICHIGAN DEPARTMENT of NATURAL RESOURCES | NEWS BULLETIN

IN THIS ISSUE:

Dick Lehman: 517-373-1214

Pages 1-4 - WHITE AMUR STIRS INTEREST AS WEED-CLEANER
Pages 4-5 - U.P. DEER UNDER WINTER'S TIGHT GRIP
Pages 5-6 - S.S. VALLEY CAMP GAINS NATIONAL RECOGNITION
Page 7 - DNR TAKING ORDERS FOR SPRING PLANTING STOCK

WEED-CLEANING WHITE AMUR BANNED IN STATE;
STIRS GUARDED INTEREST OF DNR FISHERIES MEN

LANSING---Asia's white amur, which is being ballyhooed in some quarters as a new wonder fish to control water-weed problems in this country, has stirred interest among Department of Natural Resources fisheries men, but it's not drawing any hasty open-door treatment from them.

The white amur, known as the Siberian or Chimese grass carp, is banned from private importation into Michigan under existing state rules, and the DNR is not about to lift that restriction---no matter how exciting this fish may sound for its weed-chomping capacities.

The DNR's guarded views about the white amur are explained by David P. Borgeson, who heads the Department's inland fisheries program:

"We're basically interested in this fish for the same reason a lot of other people seem to be right now. In this day of heightened environmental concern, the white amur is whipping up a great deal of attention because of its ability to gobble up large volumes of aquatic weeds.

"As such," Borgeson continues, "people see this fish as being a cheap biological tool for cleaning up weed-clogged lakes and streams, rather than going through the expensive job of applying herbicides which could be ecologically dangerous."

However, Borgeson is quick to point out, the white amur could also be ecologically dangerous because it eats just about everything that's available, including the plant and animal life which sustains populations

(more)

of game fish.

The white amur, one of the largest and fastest-growing members of the carp and minnow family, may reach 100 pounds. It is a cousin of the European carp which, on the wave of similar fanfare back in the 1890's, was brought to Michigan with the buildup of becoming a prized new food fish for this state.

As things turned out, the European carp crowded out game fish and made a muddy mess of many lakes and streams. Today, it rates no better than a noxious or trash fish in Michigan.

This time around, Borgeson is calling for more information and less emotion as decision-making bears on the white amur. As he puts it: "We made a mistake with carp; we don't want to make another one."

To avoid running such a risk, DNR fisheries men are casting an eye to research on the white amur which is being conducted by the U.S. Bureau of Sport Fisheries and Wildlife, plus several southern states.

"We want to critically review their studies when they are completed before we decide whether we should experiment with white amur here in Michigan."

If the DNR should take such a route, its experiment would come under tight controls, with the fish to be isolated for weed-eating studies in some land-locked pond. The DNR is particularly interested in the possibilities of single-sex plantings of white amur---all males---to prevent any chances of reproduction among the experimental fish.

Since it takes only a dozen or so white amur to control weeds in a one-acre pond, such experimental plantings could be made and studied in problem waters with a minimum of effort, says Borgeson.

At any rate, the DNR wants to make sure that any possible experiment be kept strictly under its close control. "This type of project is not for private individuals to undertake," cautions Borgeson. He also notes

that the state has a law against bringing such exotic species into Michigan without DNR permits.

"If some person or group tried to experiment with white amur, some of the fish could escape, and the whole thing could spread out of control to other waters."

As a case in point, the Mississippi River is already well seeded with white amur because of accidental releases from some southern states.

The white amur could conceivably take a stromg hold over many Michigan streams because it can withstand a wide range of temperatures (from 32 to more than 90 degrees Fahrenheit) and can thrive in waters with scant oxygen levels (down to as low as .5 ppm).

Although DNR fisheries biologists such as Borgeson are still genuinely interested in the white amur, a report recently received from their counterparts in California is giving them somethimg to think about.

That report, covering a review of the white amur's life history, concluded that California should continue to stand firm in prohibiting the introduction of the fish.

Underscoring the report's recommendations were these major points:

---Grass carp can effectively control aquatic weeds. However, they would almost inevitably spread to California's game fish waters if they were brought in for weed control purposes. The hardy grass carp could create problems comparable to and possibly worse than those caused by the common carp...

---Grass carp eat animal food as well as aquatic vegetation, and could therefore compete directly with game fishes which utilize small invertebrates...particularly the young of the warmwater species.

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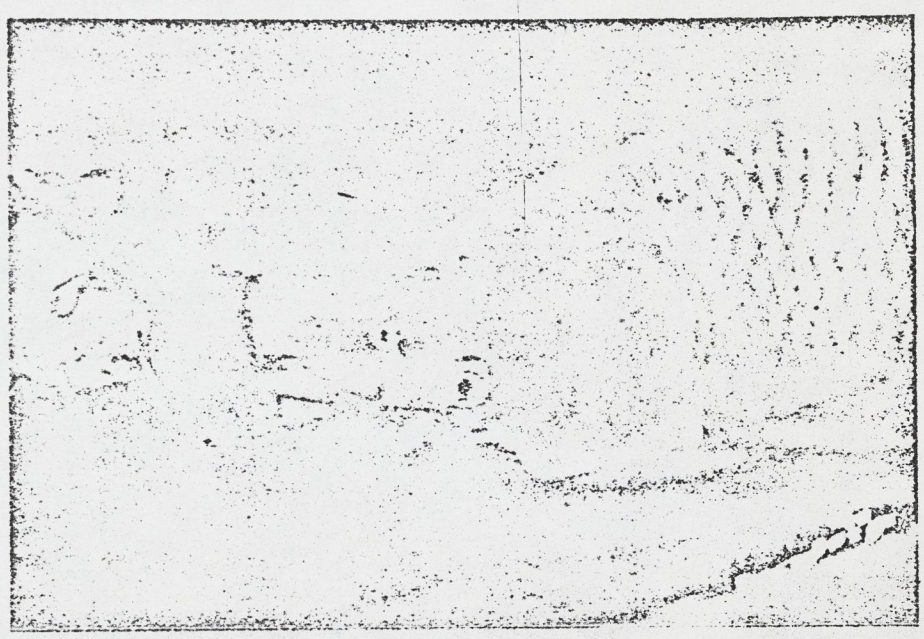
3/8/72

# The White Amur . . . A Star

By Alan Ables



The white amur has been labeled "Superfish" in the nation's news media.

Recent published information about the white amur has generated a great deal of interest in the species not only among those directly involved with aquaculture but with members of the news media as well.

Articles describing the white amur have appeared in The American Fish Farmer and the magazine has supplied newspapers such as The Washington Post and The National Observer with information for stories which have been printed in those and other newspapers from coast to coast. The headlines on the articles ranged from "Superfish" to "Can the World Stand a Real Schmoo?"

Most recently public attention has been directed toward the grass eating carp through the nation wide NBC-TV network's National Press Service broadcast system. Although the feature, filmed by a news team from Little Rock, Arkansas, was not shown on the NBC network's Nightly News, it was syndicated by the network and broadcast to hundreds of NBC affiliate stations. Indications from John Reeder, News Director at station KARK-TV in Little Rock and the reporter who wrote the story for NBC, are that the five minute long filmed feature appeared on at least a score of stations, which from letters received were apparently scattered throughout the nation.

The filming for the feature story took place late last winter at the Arkansas Game and Fish Commission Hatcheries at Lonoke. Fish Biologist Bill Keith was interviewed by Reeder and together with the editorial offices of The American Fish Farmer, provided the background material on the fish.

The white amur, it has been suggested, may possibly be the answer to a great number of pollution problems in the United States. That role would be in addition to the good food and sport aspects of the fish.

Some fisheries experts have suggested that the white amur may be able to solve Lake Erie's problem because of the white amur's love for algae. Experts feel that if enough algae were put into the lake, the white amur may be able to chew up the grass and give the lake a second chance.

Biologists who have studied the fish at the Lonoke hatchery and at Auburn University in Alabama have said that the white amur may prove a better source of protein than beef cattle at far less expense.

### Eating Experiment

The amur eats up to four times his weight in grass a day. Bill Bailey, a biologist for the Arkansas Game and Fish Commission said some 10-pound amur were put in Lake Greenlee near Brinkley in the spring of 1970. Nine months later Bailey said that the lake, described as "a solid mass of weeds," was absolutely clear of weeds. The amur averaged 18 pounds, nearly doubling their weight.

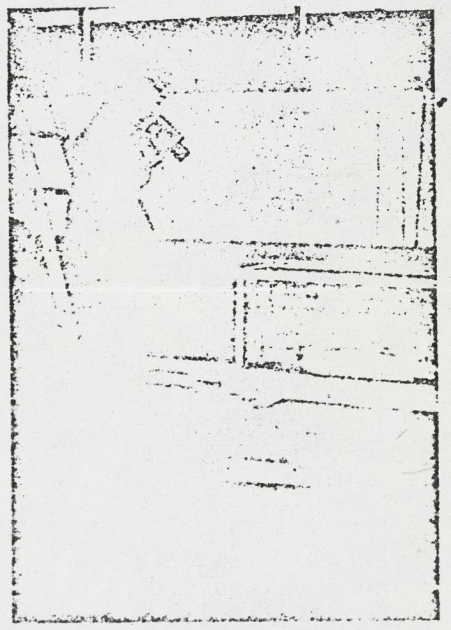
U.S. officials expect that the amur will grow up to 100 pounds when it's introduced widely in this country. They also say that records have been produced indicating that the fish can grow to 400 pounds.

### Distribution Policy Announced

At the present, Arkansas is the only state that has introduced the white amur. The Federal station in Stuttgart has one pond full of amur in storage. The Lonoke Hatcheries have a half-dozen ponds with amur. Federal Fish Control Laboratories at Warm Springs, Georgia, and LaCrosse, Wisconsin, also are experimenting with the amur. About 15-states have shown interest in the amur, among them are Alabama, Arizona, Florida, North Dakota, California and South Carolina.

In April spokesmen for the Arkansas Game and Fish Commission revealed the first distribution plans for the amur in addition to the stock already present in nine lakes, the largest of which is 7,000-acre Lake Conway in which there are 20,000 amur.

A news release from the Arkansas Game and Fish Commission in early April indicated that following some 10-years of study and experimen-



White amur is photographed during filming for NBC television network.

tation, the fish would be introduced into various lakes for the purpose of biological vegetation control.

"Since the announcement requests for the amur have steadily multiplied," according to Arkansas G&FC spokesman, George Purvis, "and as a result the Commission adopted the following policy, as presented by Fisheries Chief Bill Keith, on the distribution of White Amur from state fish hatcheries:

1. The primary utilizations and production of grass carp will be for control of aquatic vegetation in Arkansas public fishing waters.

2. Grass carp fry and/or fingerling will be furnished to State and Federal Governmental agencies and to Colleges and Universities for research purposes on a supply available basis. Small numbers will be furnished to these agencies at no charge or in a trade for other fishes. Before these fish are transported into other states, written approval must be given by the Game and Fish Agency from the receiving state.

3. At this time no private fish ponds, commercial fish farmers, or privately controlled cooperatives or corporations will be furnished with grass carp.

4. Priorities for distribution of grass carp will be:

A. Arkansas Public waters with greatest needs for vegetation control.

B. State agencies, Federal agencies and Universities.

C. Large club or community lakes in Arkansas with needs for aquatic vegetation control.

D. Private lakes or ponds used by Arkansas Game and Fish for holding or grow-out purposes.

E. As additional fry are available, limited numbers will be alloted to private pond owners after inspection and approval by state fishery biologist."

### Opposition

Kermit E. Sneed, Director of the Warmwater Fish Cultural Laboratories at Stuttgart and Kelso, Arkansas and Marion, Alabama, wrote about research with the white amur in The American Fish Farmer's May, 1971 issue. He addressed the opponents of the fish in that article.

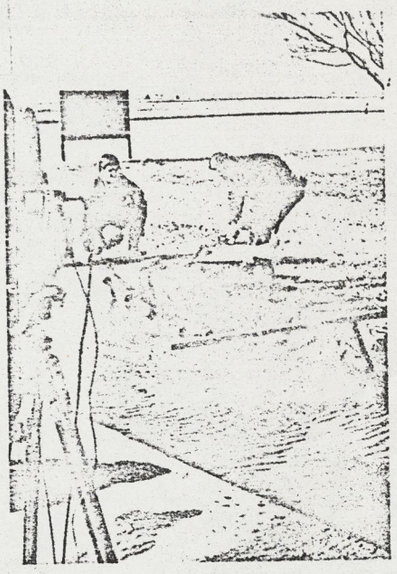
Mr. Sneed wrote: "Opponents of the use of this fish bring up several points which must be considered before the white amur can be freely used. One important consideration is the effect it might have upon the lakes and streams if released into natural waters. Little is known about ways in which the white amur would affect native fish populations adversely in a state lake in Arkansas or in a storage reservoir at the Fish Farming Experimental Station at Stuttgart, Arkansas. In fact, at Stuttgart it appears that other fish starved the white amur, which were in poor condition when harvested.

Another point which must be taken into account is the fact that native fish need some grasses and weeds for breeding and protective purposes. Some people feel that the white amur might completely wipe out vegetation in a lake in which they were used. Again, the emphasis is on control. Because wild spawning does not seem to occur, the numbers of the fish can be controlled through breeding in a laboratory situation. Therefore, the amount of plant food taken by the fish appears to be controllable also. Hopefully, research will enable us to make increasingly precise judgments as to the number of fish required for specific control per acre of water.

It has been observed that these fish are not likely to reproduce in lakes. This implies that, with proper management, populations of aquatic birds and other aquatic animals need not suffer because of the presence of the white amur.

The native habitat of the white amur is in large flowing rivers which have seasonal floods. These flood waters provide enough current to suspend the floating eggs until hatching. Thus, it should be possible to control their numbers in impoundments of any size which are not fed by rivers with these characteristics. A native fish which has similar spawning requirements is the striped bass. It is well known that this fish has been most difficult to establish in our man-made lakes, other then through artificial stocking."

Many biologists think that this species of carp and perhaps some other related kinds will fill an unfilled niche in much of the waters of North America, which at present has no fish that feeds directly on water vegetation. It is also thought that American fish farmers will eventually turn to this fish like Asiatic and European fish farmers have, if they can be convinced that it will have a ready sale in the marketplace. A noteworthy "selling" job has already begun for the white amur in the news media.



Biologist Bill Keith preparing white amur to be photographed at the Arkansas Game and Fish Hatchery at Lonoke.

# Proposals By American Fisheries Society Are Stated

(Ed. Note: Dr. Herbert Axelrod has had long and distinguished experience with almost every facet of tropical fish, and his opinions have always been regarded very highly by almost all who are connected with that field. He previously published his first draft on this Proposed Position Statement, and the present statement has been awaited with great interest. The industry will greet this work with considerable enthusiasm. Address Dr. Axelrod at: T. F. H. Publications, Inc., 211 West Sylvania Avenue, Neptune, New Jersey 07753.)

By Dr. Herbert R. Axelrod, chairman, Exotic Fishes Committee, American Fisheries Society.

Following is the second draft of the "Proposed Position Statement on Exotic Aquatic Organisms' Introductions," which reflects the suggestions made at the committee meeting of the American Fisheries Society recently in St. Louis. Please bear in mind that these are the committee's proposals and do not reflect the thinking of the Executive Committee of the American Fisheries Society.

Some introductions of species into ecosystems in which they are not native have been successful (e. g., coho salmon and striped bass), and others unfortunate (e. g., common carp and walking catfish). Our purpose here is to formulate a broad mechanism for planning, regulating, implementing, and monitoring all introductions of exotic aquatic species.

Species not native to an ecosystem will be termed "exotic." Some introductions are, in some sense, planned and purposeful for management reasons; others are accidental or are simply ways of disposing of unwanted pets or research organisms.

It is recommended that the policy of the American Fisheries Society be:

1. Encourage exotic fish importers, farmers, dealers, and hobbyists to prevent and discourage the accidental or the purposeful introduction of exotics into their local ecosystems.

a. Support legislation prohibiting all exotic fish importers, breeders, dealers, fish farmers, and governmental employees from releasing living, dead, or dying fishes into any water system, but encouraging drywells, dikes, and moats for the preservation of the ecosystem from accidental introduction of exotic fishes and fish diseases.

b. Urge the establishment of four Federal Fish Disease and Fish Culture Stations, similar to that already established as the "Eastern Fish Disease Laboratory," located in Leetown, West Virginia, and in or near Miami and Tampa, Florida, Los Angeles, California, and New York City, New York, where the majority of the exotic fish businesses are located, to assist exotic fish dealers, importers, and others, in the control of fish diseases, the culture and identification of exotic species, and to evaluate, control, and monitor exotic introductions into these areas.

c. Urge the accurate completion of existing Federal documentation for the compliance with Customs and Interior Department regulations. Form 3-177 "Declaration for Importation of Fish or Wildlife" is grossly abused, with deflated costs and generally incorrect scientific and common names.

2. Urge that no city, county, state or Federal agency introduce, or allow to be introduced, any exotic species into any area within its jurisdiction which might contaminate any area outside its jurisdiction without official sanction of the exposed jurisdictions.

3. Urge that only exotic aquarium fish dealers be permitted to import such fishes for sale or distribution to hobbyists. The "dealer" would be defined as a firm or person whose main source of income derives from live aquarium fishes.

4. Urge that the importation of exotic fishes for purposes of research not involving introduction into a natural ecosystem or for display in public aquaria by individuals or organizations be made under agreement with responsible government agencies. Such importers will be subject to investigatory procedures currently existing and/or to be developed, and species so imported shall be kept under conditions preventing escape or accidental introduction. No fishes shall be released into any natural ecosystem upon termination of research or display.

5. Urge that all species of exotics be prohibited and considered undesirable for any purposes of introduction into any ecosystem unless that fish shall have been evaluated upon the following bases and found to be desirable:

a. Rationale. Reasons for seeking an import should be clearly stated and demonstrated. It should be clearly noted what qualities are sought that would make the import more desirable than native forms.

b. Search. Within the qualifications set forth under Rationale, a search of possible contenders should be made with a list prepared of those that appear most likely to succeed, and the favorable and unfavorable aspects of each species noted.

c. Preliminary Assessment of the Impact. This should go

*(Continued on Page 76)*

# American Fisheries Society State Proposals

*(Continued from Page 14)*

beyond the area of rationale to consider impact on target aquatic ecosystems generally, effect on game and food fishes, on waterfowl, on aquatic plants, and on public health. The published information on the species should be reviewed and the species should be studied in preliminary fashion in its biotope.

d. Publicity and Review. The subject should be entirely open and expert advice should be sought. It is at this point that thoroughness is in order. No importation is so urgent that it should not be subject to careful evaluation.

e. Experimental Research. If a prospective import passes the first four steps, a research program should be initiated by an appropriate agency or organization to test the import in confined waters (experimental ponds, etc.). This agency or organization should not have the authority to approve its own results or to effect the release of stocks, but should submit its report and recommendations for evaluation.

f. Evaluation of Recommendation. Again publicity is in order and complete reports should be circulated among interested scientists and presented for publication in the "Transactions of the AFS."

g. Introduction. With favorable evaluation, the release should be effected and monitored, with results published or circulated.

6. Because animals do not respect political boundaries, it would seem that an international, national, and regional agency should either be involved at the start or have the veto power at the end. Under this procedure there is no doubt that fewer exotic introductions would be accomplished, but quality and not quantity is desired, and mistakes might be avoided.