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RESEARCH ON EXOTIC FISH SPECIES

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INTRODUCTION

Exotic fish species in North America are regarded with skepticism, mainly because of the detrimental effects of introducing the common carp (Cyprinus carpio) from Europe in 1831 (Lachner, et al, 1970). This cyprinid, a native of Asia, has invaded river systems from Canada to Florida and is regarded as a serious pest because of its disturbance of the habitat, its ability to occupy a wide variety of habitats and its predation on eggs of other fishes (Lachner, et al, 1970). Twenty-four additional exotic species have become established in waters of the United States, exclusive of Hawaii. These include one trout (Salmonidae), five minnows (Cyprinidae), one loach (Cobitidae), one catfish (Clariidae), five livebearers (Poeciliidae), two drums (Sciaenidae), seven cichlids (Cichlidae), and two gobies (Gobiidae). Except for Sciaenidae and Gobiidae, all are freshwater species. Other fishes have been introduced through the aquarium trade, and caught from North American waters, but their establishment has not been demonstrated.

EXOTIC FISHES STUDIED AT AUBURN UNIVERSITY

The following species have been used in experiments at the Department of Fisheries and Allied Aquacultures at Auburn University during the period 1955 to 1971

Family	Species	Year Introduced	Source
Cichlidae	Tilapia mossambica	1954	California
Cichlidae	T. aurea	1957	Israel
Cichlidae	T. melanopleura	1960	New York
Cichlidae	T. melanotheron	1961	Florida
Cichlidae	T. hornorum	1968	Puerto Rico
Cyprinidae	Cyprinus carpio	1955	Israel
Cyprinidae	Ctenopharyngodon idella	1964	Taiwan
Clariidae	Clarias batrachus	1969	Florida

With the possible exception of T. aurea, all these fishes had already been introduced into the U. S. by other fishery researchers, or aquarium dealers. All fishes at Auburn University were kept in controlled environments during experimentation to determine their value as weed control agents or as food fish, and to discover certain aspects of their biology such as temperature tolerance and food habits. The results are discussed below.

Tilapia mossambica

Kelley (1957) reported that T. mossambica (from Java) was more efficient under similar conditions of feeding and fertilizing than the bluegill sunfish (Lepomis macrochirus), and that major food items were phytoplankton and zooplankton. Minimum temperature tolerated by this tropical fish was 6 C, therefore, it could not survive in winter in Alabama ponds. Swingle (1960) demonstrated that T. mossambica

was a very efficient pond fish, producing 4,820 kg/ha in 191 days with feeding. It is also a good sport fish, some 650 kg/ha being caught by anglers in 2 months. As a biological weed control agent, T. mossambica was not very effective (Avault, et al, 1968), substantiating the premise that this fish was primarily a feeder on plankton and debris.

Tilapia aurea

This fish, from Israel, was originally reported as T. nilotica (Swingle, 1960). It was slightly less efficient than T. mossambica as a pond fish with feeding, producing 4,400 kg/ha in 208 days. T. aurea could not be taken by angling as easily as T. mossambica, but was superior as a food fish. McBay (1961) showed that large T. aurea fed extensively on filamentous algae, but tests by Avault, et al (1968), indicated that this fish was not efficient in controlling higher aquatic plants, and that it was generally a plankton feeder. Pagan (1969) showed that when T. aurea was cultured in cages using nutritionally complete feeds, it did not successfully reproduce. This simple population control for mouth breeders is being widely tested with tilapia in several countries.[1]

Tilapia melanopleura

This species, originally from Africa, is an effective herbivore and controlled several species of higher aquatic plants when stocked as 10-cm fingerlings in bass-bluegill ponds at 2,470 to 4,940 per ha (Avault, et al, 1968). Several weeds which were eliminated or appreciably reduced in 3 months were: Pithophora sp., Spirogyra sp., Eleocharis sp., Elodea sp., Hydrochloa sp., Utricularia sp., Rhizoclonium sp.,

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[1] H. S. Swingle, personal communication.

Myriophyllum sp., Spirodela sp., and Najas sp. Byrd and Crance (1965) reported that T. melanopleura did not interfere with growth of bass and bluegill when stocked at 2,740 per ha, indicating negligible overlap of food habits with these carnivorous species. Although it could be taken with hook and line, T. melanopleura was not as easily caught as T. mossambica.

Tilapia melanotheron

This species, once called T. heudaloti, has established itself in brackish-waters of Tampa Bay in Florida, where it escaped from tropical fish hobbyists (Lachner, et al, 1970). The fish is so abundant in Tampa Bay as to be caught by commercial fishermen, but its effects on native fishes of the area have not been demonstrated. A stock of this fish was brought to Auburn in 1961, where results in fertilizer and feeding trials were very poor, so it was not considered further for culture.

Tilapia hornorum

Hybrids produced by crossing the ♂ T. hornorum with the ♀ T. mossambica have been reported to be all male, producing an ideal culture animal requiring no further population control (Hickling, 1968). Some specimens of T. hornorum were brought from Puerto Rico in 1965, for the purpose of experimentation for population control. The fish were apparently not of pure strain, however, and offspring were only 70 per cent male.[1] The brood stock were destroyed, and experiments discontinued.

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[1] Unpublished Annual Report of Fisheries Research for 1970, Auburn University.

Cyprinus carpio

A selected strain, called mirror carp, was introduced from Israel by way of Central America in 1955. This fish was deep-bodied, had few scales, reportedly was less likely to muddy waters than the common carp, and supposedly was effective in controlling filamentous algae. Experiments by Avault, et al (1968), showed that the carp was only moderately effective in weed control, probably then only by indirect means of muddying and disturbing root systems of plants while it fed at the bottom of ponds.

Ctenopharyngodon idella

This herbivorous cyprinid, first introduced into U. S. waters by the U. S. Fish and Wildlife Service in Arkansas, was brought to Auburn from Taiwan in 1964.[1] This fish, called grass carp or white amur, has been widely distributed from its native China for production of food and for control of aquatic vegetation. Experiments at Auburn have shown that the fish can be spawned in confinement only by hormone injections (Jeffrey, 1970) and is very effective in controlling aquatic weeds (Avault, et al, 1968). Grass carp, 25 cm long, stocked at 25-100 per ha has eliminated heavy growths of algae, including Hydrodictyon sp., and has prevented the establishment of higher aquatic weeds in fertilized, and in fed ponds. In aquaria, pool and pond tests, the following order of preference by the fish for weeds was established: (1) Chara sp., (2) Najas guadalupensis, (3) Potamogeton diversifolius, (4) Eleocharis acicularis, (5) Ceratophyllum demersum, (6) Bacopa rotundifolia, (7) Elodea densa, (8) Myriophyllum spicatum, (9) Vallisneria americana,

[1] Unpublished Annual Report of Fisheries Research for 1964, Auburn University.

(10) Eichornia crassipes, (11) Myriophyllum brasiliense, (12) Alternanthera philoxeroides. Grass carp grow 2-3 kg per year on aquatic vegetation at Auburn, and compete to a negligible degree with native fishes for insects and other food items in ponds (Kilgen and Smitherman, In Press). Current experiments include determination of methods of producing mono-sex populations of grass carp which will minimize dangers of accidental introduction into open waters of the U. S. The grass carp is a temperate species which spawns in flowing water of larger rivers in its native habitat. There is some possibility of its spawning in U. S. rivers, and adding significant numbers to the fish fauna. However, survival of grass carp fingerlings in ponds has been poor when largemouth bass were present.

Clarias batrachus

The "walking catfish", a tropical species, was introduced into Florida from Thailand by aquarium fish dealers (Lachner, et al, 1970). It has become established in certain Florida waters, and created much concern since it had no natural predators or competitors. Temperature tolerance tests were done at Auburn (Pardue, 1970) which indicated that Clarias batrachus could not survive temperatures lower than 7.2 C. This tolerance was similar to that exhibited by T. mossambica, which could not survive winter cold at Auburn. Further field testing of Clarias batrachus was not done, because of the potential harm to native species. However, it is known that this fish can be grown at high density and receive extremely heavy feeding rates because of its ability to surface and gulp air when water becomes foul (Swingle, et al, 1970).

DISCUSSION

Exotic species should be carefully considered before stocking these outside their native habitats. A thorough documentation of the need for possible introductions should begin with the inventory of native species. Some may be similar in habitat and food requirement, and therefore might be displaced by introduced species, or might serve the purpose of the species proposed for introduction. Examples are Petenia, Cichlasoma, and Astronotus, which are native Colombian cichlid species similar in many respects to certain Tilapia sp., which originated in Africa and have been widely introduced for food fish production. Colombia and other Central and South American countries have many species of freshwater catfishes, the Amazon Basin alone containing over 500 species. In the United States, there are only 38 species of freshwater catfishes (Bailey, et al, 1970), of which 10 are considered edible. Five of the species have been cultured in ponds, and three species form the basis of an important industry, with some 20,000,000 kg produced commercially in 1970.

The potential for finding desirable species for culture among native Colombian fishes is much greater than that which existed for North American freshwater fish culturists. It is only logical to take advantage of the greater number of species available, and the adaptation to environment over millions of years by native species.

Techniques for testing fish in ponds for desirability as food or sport animals such as those used at the International Center for Aquaculture should be used, but species placed in trials should first be native ones.

RECOMMENDATIONS

The Auburn Department of Fisheries and Allied Aquacultures tested most desirable native species for use in pond culture before considering other fishes. The following general criteria were used in planning for possible stocking of exotic species and should be generally followed:

1. Determine a real need for the introduction of a new species.
2. Evaluate all life history aspects and characteristics of native species and the proposed species, including growth rate, food habits, fecundity spawning, possible competition, and acceptability as food or sport to people expected to utilize the new fish.
3. Determine that a vacant ecological niche shall be filled by the introduced species.
4. Study potential disease problems and establish quarantine procedures.
5. Conduct preliminary experiments within a controlled environment, since most introductions are irreversible.

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