THE USE OF THE CARPS AS WEED CONTROL ORGANISMS IN FISH PONDS

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Abstract

Carps have been used by various countries for the biological control of weeds in aquatic habitats. The common carp is omnivorous, consuming a variety of plant and animal tissues. It does not require any costly food, as it consumes refuse and other natural products which are otherwise useless. The Grass carp n the other hand is more or less herbivorous. It can consume virtually all forms of water plants; it has a high feeding adaptability and it also grows very rapidly. Grass carp and common carp can be used as effective low-cost organisms for the management of nuisance plant abundance without drastically altering water quality of ponds and lakes. The need to maintain an ecological balance between the Grass carp, the aquatic vegetation and the indigenous fish population must be the starting point in considering the introduction of the carps into natural waters as weed control organisms. An attempt has been made in this paper, to discuss the food of the carps, as well as the ecological significance of their feeding habits as regards their usefulness in controlling nuisance weeds in fish ponds.

Introduction

In many countries today the practice offish culturing is becoming widespread. The control of weed in the ponds is therefore a major problem for many, since the chemical weedicides which are commonly used are hazardous to the fish populations. Hence knowledge of the use if phytophagous fish in these ponds is necessary.

Much research has been carried out on the use of the carps - grass carp *(cteuophaiyngodon idaUa)* and common carp *(Cypranus carpio)* for the biological control of aquatic plants. These fish are currently being used as weed control organisms as well as food in a number of countries (Kulshreshtha and Shireman, 1976). in places like the United States, their use was delayed because little information existed concerning their food habits and their effect on water quality and native fish populations (Rottman, 1977). In Nigeria very little information is available.

The Food of the Carp

Carp are omnivorous and consume a variety of plant and animal tissues. The grinding of plant tissues is greatly facilitated by the molar-like surfaces of their pharyngeal teeth (Scott and Grossman. 1973). Molluscs comprise a significant portion of the diet of the common carp, *Cyprimts carpio* (Dill. 1944: Sigler, 1958; Pcarse, 1975).

Generally, carps have little selectivity for specific foods (Vaas and Vaas-van Oren, 1959). Based on preliminary research in Skadar Luke by Stein et al. (1974), it was observed that carp appeared to select one species of several benthic mollusks available but the most preferred was *Valvata,* this may be because this mollusk has:-

(a) A thin shell
(b) A turbinate physical shape
(c) A large proportion of occupied shells
(d) High organic content (Stein et al, 1974).

The common carp, though well suited for feeding on bottom insects and other small invertebrates, can feed predominantly on vegetation and can take small fish on some occasions (Bond, 1979).

Grass carp *(Cidella)* is a voracious vegetable feeder and its ability to assimilate large quantities of aquatic plants is well documented (Krapaurer, 1967; Prowse, 1971). Much controversy remains as to its order of preference for plant and animal foods, its relative requirements of each, and its interrelationship with associated fish species. However, it exhibits a definite preference for some species of plants over others (Rottman, 1977). It was also discovered that sub-merged plants and some types of floating vegetable are preferred over emergent and terrestrial types. The preferred plants are typically young and succulent with little or no fiber. Fibrous and woody plants are least preferred (Prowse. 1971). Opuszynski (1972) found that submerged plants are most desired by grass carp. The aquatic plants which are readily consumed include Elodea *Canadensis, CeralophyUum demersuim, Potamogehn* and *Hydrilla Verlicillaia.* Aliev (1963) and Verygin et al., (1963) are of the opinion that even Typha species and *Phyragmites communis* at a height above one metre are also readily consumed by grass carp. They observed that grass carp first breaks a high *P. communis* consumes them together with the soft upper part of the stem. *Typha* which is not so hard as reed is broken at the base of the shoot and then eaten in toto.

Opunzyski (1972) similarly observed the reed breaking and *Typha* consumption of *Schoenoplectus lecustris* by grass carp in the ponds of the Department of Fish Culture, Inland Fisheries Institute at Zabienke near Warsaw. Filamentous algae are most frequently mentioned as the most attractive food for grass carp (Avault, 1965; Penzes and Toly, 3966). The grass carp has a unique development of the pharyngeal teeth which facilitates cutting and shredding of plant materials, and has become the subject of wide interest because of its potential use in the biological control of aquatic weeds (Buck et a!, 1975).

It has been observed that, pond cultured grass carp are omnivorous (Nikolsky, 1956). In addition to plant food, such as grass, aquatic plants, tree leaves, fruits' bran and oil cake, this fish also eats small animals such as bombyx pupa, and insects. However, under natural conditions the animals are less vulnerable. Edwards (1973) demonstrated that when stones were provided as a substrate and cover in aquaria, grass carp consumed few invertebrates. They are predominantly surface and mid-water feeders, and so may take worms and other baits suspended in the water column when weeds are absent (Terrel and Fox. 1975). According to Fisher (1977) consumption is lower when grass carp are fed exclusively animal food and higher when fed plant foods.

Several field experiments have proved that carp preferred some plant species to others. Tan (1970) fed several types of vegetation to grass carp in ponds and found *Hydrilla Verticulata* to be excellent food. Fish fed Napier grass *(Penisetum Porporem}* grew slower than those fed *Hyydrilla. Hydrilla* '.v superiority as a food item was attributed to the attributed to the soft nature of the plant (low fibre) and high ash (mineral) content. According to Tan (1970) and Stanley (1974) high protein content does not necessarily indicate diet superiority. For example, according to Shireman et al (1978) in an experiment on feeding of grass carp with four experimental diets, it was observed that large carps fed duckweed, catfish chow and catfish chow-rye grass diets ingested equal amounts of total protein, but did not grow at equal rates. If essential amino acids are lacking, fish will utilize nutrients for energy rather than growth (Stanley, 1974).

Terrel and Fox (1975) observed that in a 3.6 ha lake with neither macrophytes nor artificial feeds, but with abundant benthic organisms and an established fish population, animal remains made up no more than 0.2% of the total stomach contents of grass carp in any month. Terrestrial plants are the most abundant food item. No fish or fish eggs were observed Terrel and Fox (1975) concluded that in the absence of aquatic vegetation, grass carp did not utilize benthic organisms or become Piscivorous, even though they were losing weight. Kilgen (1974) also reported little use of crustacean and insect larvae by grass carp in a vegetated pond containing a suppiementally fed large mouth brass, bluegill, and redear sunfish populations. It was concluded that grass carp rarely ate anything except plant material and the small number of invertebrates found in grass carp stomachs was probably inadvertently ingested with the vegetation. Similar feeding habits were reported by Mitzner (1976) for grass carp in Red Haw Lake, Iowa, U.S.A.

Ecological Significance of Carp Feeding Habits

Grass carp has attracted the attention of fishery managers because of its biological characteristic. It has a high feeding adaptability and grows rapidly, it is cold resistant and has the ability to withstand low oxygen concentrations (Vinogradov and Zolotova, 1974). Furthermore, the rearing of a direct consumer of higher plants in overgrown waters has created the pre-requisites for a considerable increase in fish out-put per unit area by direct utilization of the aquatic vegetation.

It has become clear that the grass carp by its intensive consumption of macrophytes is capable of disrupting its own food resources within a short period (Vinogradov and Zolotova, 1974). This was the reason why the unjustified passion for heavy stocking of grass carp in most of the pond farms in USSR, especially in the southern regions, led to the total elimination of the weed beds in the ponds.

In addition, it was observed that when irregularly fed under these conditions, the grass carp, which is exclusively a plant-eating fish within its natural range, was readily able, by virtue of its high feeding adaptability, to enter into competitive food relations with the indigenous fish species. This led to disruptions in the existing tropic relationships and to the appearance of new ones.

Analysis of data obtained mainly from the rearing of grass carp in fish farm ponds b>

Vinogradov and Zolotova (1974) has shown that the hydrobiology and hydrochemistry of the ponds are appreciably altered for the belter as a result of its activity. Certain water bodies used for individual purposes and agriculture, for example, irrigation ditches, the cooling ponds of thermal power stations, rice paddies, e.t.c., must be rapidly cleared of weeds. In this case, high stocking densities of the grass carp improve such waters and the specific characteristics of this extremely gluttonous phytophage are used to the full extent. There is great promise in the rearing of the grass carp in reservoirs and natural water.

Since grass carp in ponds and lakes consume insignificant quantities of benthic invertebrates, and no small fish or fish egg (Terrel and Fox, 1975), changes in the abundance of these organisms are in response to aquatic vegetation reduction (Rottman, 1977). The biomass of benthic organisms (g/m^2) was slightly lower in ponds where grass carp controlled submerged vegetation as compared to weeds ponds, but the difference was statistically insignificant (Rottman, 1977). The density of glass shrimp *(Pafaewojwfe.s Kadhtkensis}* in these ponds was not affected by grass carp, but blue-gills significantly lowered the abundance of these micro-invertebrates. A shift from plant associated benthic organisms to more open bottom-dwelling types would be expected with vegetation reduction (Rottman, 1977).

The great benefit in fish production obtained from the introduction of grass carp in polyculture fish farming is well documented (Rottman, 1977). In Russia, the use of plant-eating fishes resulted in an increase in the average production in ponds from 480kg to 900kg, Nikolsky (1963i reported increased fish production in ponds of 50%-100%. Although grass carp may feed on pelleted fish food, the production of channel catfish in weed-free ponds was not affected by the presence of grass carp (Forester, 1975). In small ponds with dense vegetation, control by either grass carp or herbicide resulted in increased blue-gill and golden shiner production (Buck eta!., 1975). When grass carp were stocked in weed}' ponds, the resultant decrease in submerged vegetation had a positive effect on the reproductive success of bluegills and fat head minnows (Rottman, 1977). Production and condition of these species were not significantly different in ponds with and without grass carp. Because of the rapid growth of grass carp, the addition of this species increased the total fish production of these ponds by 270% (Rollman, 1977). This supports the statement by Cure (1970) that grass carp makes profitable a tropic level little or even non-utilized by the native species, changing it into useful production (Fish meat of good quality and increase in the fish crop per hectare).

The dense cover provided by submerged vegetation communities can reduce the vulnerability of young bluegills and other prey species to largemouth bass predation. Increasing amounts of vegetation in a Missouri reservoir resulted in a reduced feeding activity (as determined by stomach contents) and growth of bass (Heman et al. 1969). Bass in lakes with excessive submerged vegetation grew rapidly during the insect feeding stage (< 200m < 7-8 inches), but grew at greater lengths when fish are needed as forage (Hickman and Congdom, 1972), Forage-size fish inhabit dense submerged vegetation; piscivorous bass however are rarely abundant in submerged plant beds, but are frequent!) Observed at the periphery (Barnett and Schneider, 1974). Michaelson (1970) concluded that bass are inefficient predators in dense submerged vegetation, and so bluegill populations in weedy Missouri ponds were non-vulnerable and crowded, producing few harvestable size fish. Similar conditions were reported by Thomaston (1962) in Georgia ponds with excess submerged vegetation. Reduction of submerged vegetation by grass carp would logically increase the vulnerability of prey, improve the growth rate of bass and the quality of fish populations (Rottman, 1977).

In addition to reduction of the aquatic plants, stocking with grass carp may induce a considerable change in biocenosis (Opuszynski, 1972). Stocking of Lichen Lake with grass carp was a direct cause of alterations in species composition and number of fishes in this lake. This was the result of the destruction of spawning grounds as fish laid their eggs on the aquatic plants.

Since grass carp possesses strong pharyngeal teeth with sharp mastication surfaces, the food becomes highly disintegrated. According to Hickling (1966) the plant particles, after passing through the alimentary tract are smaller. Assimilation of food in grass carp is relatively low. In fish fed exclusively on plants, the assimilation under aquarium conditions amounted to only 20% (Fischer.1970). This activity of grass carp results in passage into the environment of large quantities of highly disintegrated and only partly digested plant mass (Opuszynski, 1972). This process may induce an intensive fertilization of water bodies, since grass carp excrements are easily decomposed by micro organisms and may enrich the environment by making available large quantities of nutrients required for the growth and development of phytoplankton. In consequence, reduction of macroflora by grass carp may indirectly contribute to the development of other groups of aquatic plants. However, this could lead to some undesirable phenomena such as water blooms (Opuszynski, 1972). In addition, due to procession of a vast mass of plant raw materials under natural conditions by grass carp, the food resources of waters may be indirectly affected. The composition of fish fauna and the distribution of the various fish species are also affected (Kohan, 1972; Ahling and Jernelov, 1971; Popcscu, 1962).

It was observed by Vinogradov and Zoiotova (1974) that long term rearing of plant eating fishes including grass carp, in the Oktabriskoye and Shenzhishoye reservoirs in Krasnodar territory was followed by complete reconstruction of the fish found. Perch and Pike disappeared from the catches, and stocks of crucian carp and black sea rouch were considerably reduced.

Nagamura (1958) reported that the use of the grass carp for seven (7) years to clear an irrigation pond reduced crayfish production in half. He also observed a slightly lower than usual yield of pond carp owing to the partial conversion of the grass carp to feeding on benthos.

The transplantation of grass carp into swampy lakes, lagoons, the delta areas of rivers and other water there are vast stocks of plants will help to enrich their fish fauna and will be quite effective in increasing natural fish productivity. The total biomass of vegetation in the Danubian lagoons exceed 700 thousand tonnes (Konehyakova, 1968), 200 thousand tonnes of this vegetation is submerged plants. The consumption of this can yield at least six thousand tonnes of fish if the lagoons are stocked with grass carp.

Conclusion

The rearing of carps in fish culture ponds is highly advantageous. Apart from functioning as weed control organisms, they also increase the harvest easily since no special fish feeds are required. Although, the presence of carps in ponds could lead to the growth of other groups of aquatic plants as a result of increase in fertility of the water body, leading to water blooms, stocking with grass carp may also lead to reduction of other fish populations as their breeding grounds (the aquatic plants) may be destroyed by the carp. However, the advantages of stocking with carps far outweigh the disadvantages.

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