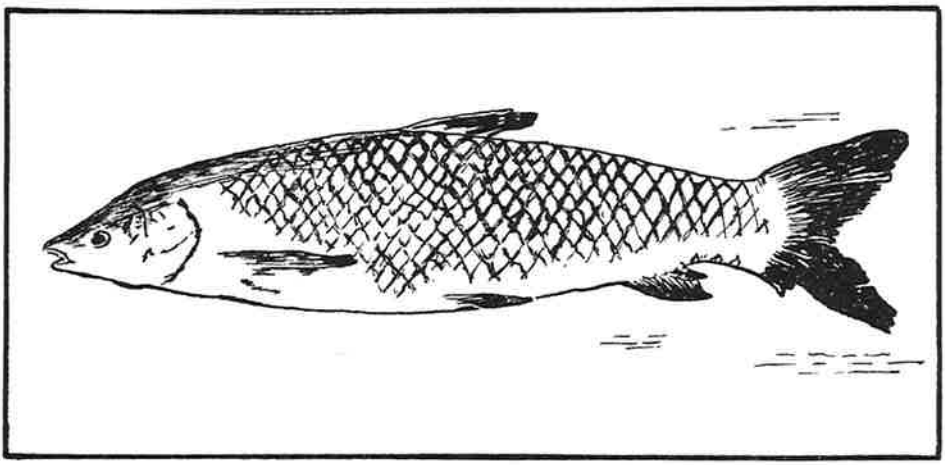
GRASS CARP IN NEW ZEALAND



NATURE CONSERVATION COUNCIL

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GRASS CARP IN NEW ZEALAND

Excessive weed growth in lakes, rivers, ponds, drainage ditches, and irrigation channels has been a problem in New Zealand since about 1960. Causes are often difficult to assess but include the clearing of lake shores which has allowed nutrients an easy access to the water, ideal water temperatures for weed growth, the introduction of exotic plant species, dams and other man-made structures on lakes and rivers, and the enrichment of waters following the economic development of catchment areas. Weed in inland waterways interferes with recreation, angling, and commercial use and spoils the appearance of the water.

Control methods, including some harvesting and the use of chemicals have been tried. Mechanical harvesting which has not yet been introduced could be a promising method although it can be expensive in terms of machinery and labour. Arsenic content in the weed from thermal areas makes it unsuitable for use as stock fodder. However, the weed is 95% water and once dried may be easily disposed of with the advantage that the weed is removed from the waterway by this process. Diquat, a herbicidal spray, is successful in clean water. The weed collapses and falls to the bottom to be consumed by an indigenous lake growth *Nitella hookeri* which thrives until the weed grows again and suppresses the native plants. However, Diquat inhibits the reproduction of certain species and may cause other long-term damage in the environment.

On 15 March 1971, Cabinet approved in principle the introduction of grass carp, *Ctenopharyngodon idella,* for evaluation as a biological agent for the control of nuisance weeds and approved the expenditure of $26,000 for setting up an experimental station at Rotorua. It was estimated that seven year's successful research would be required before grass carp could be released safely into the natural environment.

Two thousand grass carp were imported from Hong Kong in 1971, but 1500 subsequently died from various parasitic infestations including "white-spot" disease which is common throughout the world. However, after a two-year incubation period the remaining 500 fish were disease free.

In 1973 an experiment was begun in a drainage ditch on private land in the Rangitaiki Plains. The next stage proposed is a study with trout. The behaviour of trout would be monitored in two enclosures for a year before the introduction of grass carp into one of the enclosures. Observations could then be made on the behaviour of one species in relation to the other in more natural conditions. A suitable site has been found at Lake Rotoehu, but there is strong opposition to the continuation of these experiments in a valuable trout area.

HISTORY

Grass Carp originated in the Amur River on the Chinese-Russian border. They are long-lived fish and grow rapidly up to 50 kg. As a good source of protein they are widely used for food in Asia. Russia has used them to keep drains clear for twenty years, but elsewhere it is only in the last five years or so that their suitability for use as a biological control has been considered. Most of the grass carp introduced into weed-infested waters have been only partially controlled, although they have now been banned from seven states in the United States of America.

PHYSIOLOGICAL FACTORS

Grass carp have a chewing apparatus suitable for a vegetable diet. Their hard-ridged teeth grind against each other and against a thick horny pad, the masticatory plate, in the roof of the pharynx. The length of the gut, however, suggests that the fish may not be well adapted to a wholly vegetable diet. Large quantities of undigested plant food in the faeces indicate that the fish do not digest plant matter efficiently and about 50% passes through the fish wholly undigested. Consequently adult grass carp will consume large quantities and at suitable water temperatures will take in more than their own body weight of waterweeds each day. There is little feeding in water temperatures of less than 10 C and grass carp become less selective as the temperature of the water increases.

FOOD PREFERENCES

Food consumption varies during the life cycle of the grass carp.

FRY – rotifers, infusoria, zooplankton, and some phytophankton.

SMALL FINGERLINGS – zooplankton, small crustaceans and amphipods, chironomids, and tubifex

LARGE FINGERLINGS – crustaceans and amphipods, chironomids, duckweed, and tender plants

SUB-ADULTS – tender plants, shoots of macrophytes, and some animal matter

ADULTS – 95% or more macrophytes

Adult grass carp have definite plant preferences and selectively feed whenever possible, although they will eat almost any vegetation when forced to do so. But they will not necessarily consume problem plants or stay where they are stocked. Although grass carp have taken trout fry in aquaria there is no data indicating predation on fish eggs and fry in nature. Certainly young grass carp in aquaria prefers invertebrates and fish fry even when abundant palatable weed is available. Their growth seems to be retarded when animal food is not available.

In an artificial environment, Edwards (1975) established the adult grass carp's approximate order of preference for New Zealand waterweeds. (Major problem lake weeds are asterisked.)

Nitella hookeri
Lemna minor (duckweed)
**Elodea canadensis* (Canadian pondweed)
Callitriche stagnalis (starwort)
Paspalum sp. (water grass)
Nasturtium officinale (watercress)
Potamogeton crispus
Azolla rubra
**Ceratophyllum demersum* (hornwort)
Myriophyllum propinquum (milfoil)
**Lagarosiphon major* (oxygen weed)
**Egeria densa*
Polygonum decipiens (willow weed)
Mimulus guttatus (monkey musk)

REPRODUCTION

Grass carp can tolerate about one-third sea water and water temperatures ranging from 0 - 50 C. In the tropics grass carp will mature in one - two years, but may take up to fourteen years in Siberia. Grass carp in New Zealand (approximately 300) were still immature at three years, but are now near maturity. The fish have a high fecundity and one fish weighing 7.5 kg produced 800 000 eggs.

For reproduction, at about six years, carp need flowing water, about .6 m per second, and temperatures between 20 - 30 C. Eggs take about 36 hours to hatch and the pro- and post-larval development takes about 20 days during which the fry are carried downstream on the current.

The Amur River is 3690 km long and it is possible that in our relatively short rivers the eggs would wash out to sea before they are hatched. But natural reproduction has occurred in rivers in Mexico, USSR, Phillipines, Japan, and Taiwan and it is possible that suitable water flow conditions may be available in New Zealand, especially in the Waikato River and its tributaries, or in the Ruamahanga River.

If grass carp are to be introduced into New Zealand waterways it would be preferable to breed them in aquaria and stock rivers and lakes only with fish above the animal-eating age.

Grass carp can be artificially spawned after hormone injections. It may be possible to establish monosex populations, although it has not yet been confirmed that spontaneous sex reversal would not occur in these conditions.

ADVANTAGES

The Fisheries Research Division of the Ministry of Agriculture and Fisheries which is conducting the current experiments with grass carp in New Zealand has no intention of releasing the fish into inland waters until they are satisfied that there will be no danger to native flora or fauna.

Provided it does not breed, grass carp would be a suitable management fish and an especially useful tool for the management of aquatic resources in closed systems.

Grass carp have been successfully used for vegetation control in many parts of the world. In Osbysjon Lake in Sweden grass carp were introduced in 1969-72. After one year the lake weed was reduced by 50% and eliminated completely during 1973. Dissolved oxygen content and phosphorus levels increased as did turbidity and phytoplankton biomass, but these may not be permanent. Studies are continuing.

In Russia, 50 - 100 grass carp will keep one hectare macrophyte-free.

Grass carp can be a good source of food and could contribute to commercial fisheries. Because it is a strong fighter and swimmer it also has potential as a sport fish.

DISADVANTAGES

In thermal areas, because of the high arsenic content of the waterweed it is unlikely that grass carp would be suitable for human or animal consumption.

The fish are unlikely to improve water quality or affect the rate at which waters are becoming enriched. Their habit of only partly digesting vegetative matter leads to a "green-manuring" process which could fertilise the water and lead to plankton blooms which may be harmful to other fish. Plankton blooms may also occur with the use of Diquat as the weed is killed, but not removed from the water.

If, because of food preferences, grass carp eat only unimportant weeds, problem weeds could grow even more rapidly to fill the spaces created. Alternatively, grass carp could clear trout streams of most of their vegetative habitat leaving little cover for trout and trout food. They may compete with trout for food or destroy weeds on which some trout food, such as the snail *Potamopyrgus,* feeds.

Grass carp could also affect invertebrate populations, destroy spawning areas, and compete with native species. Current overseas research data is conflicting and results vary from a 10-fold increase in fish production to a 90% reduction in native fish.

Grass carp have the potential to destroy any plant community and denude grounds on which duck and water-fowl feed. They are known to feed on plants favoured by water fowl and the black swan population in the Waikato could be in particular jeopardy. Removal of soil-binding plant cover may also accelerate bank erosion.

Because of their established habit for selective feeding grass carp are certain to spread far from where they are initially stocked. They are known to have crossed the brackish Caspian Sea in search of better feeding grounds.

Like mechanical harvesting and the use of chemicals, the introduction of grass carp can only be a control measure to improve the aesthetic appearance of our inland waters and make them more accessible for recreation. But in view of the disadvantages listed above and because other introductions, the rabbit, opossum, deer, magpie, and mynah have settled down so readily, any decision to release grass carp in to New Zealand waters must be very carefully considered.

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