Chapter 38
The Good and the Bad in Releasing the Grass Carp *Ctenopharyngodon idella* in the Freshwater System: Recommendations for the Policymakers in Iraq

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Abstract Plants dwelling in water habitats are useful and an essential part of the freshwater system. In addition, a few variety of plants are the main food supply for creatures living in the aquatic areas. Plants are competent to alleviate sediments, recover water clearness and enhance variety in the shallow regions of the freshwater body. Besides, dense plants can cause irrigation problems. The goal of the study at hand chapter is to give a short, but concentrate review on the good and bad points of releasing and introducing grass carp into the freshwater system to control aquatic vegetation. Also, this chapter highlights the status of the grass carp in the Iraqi freshwater system and at the end, a recommendations were given to be taken by policymakers in countries like Iraq to save their freshwater system.

38.1 Introduction

Grass carp (*Ctenopharyngodon idella*) is adaptive to large river systems of eastern Asia. The Amur River on the Russian and southward to the Chinese border is its natural distribution (Pípalova 2006; Bozkurt et al. 2017).

There are contrasting reports about the grass carp, some in a favourite of releasing this species in the freshwater system to control growth of macrophytes (Leslie Jr. et al. 1987; Wells et al. 2003), others contemplate that the grass carp has the impending capacity to produce abundant ecological damage to the freshwater

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systems (Leslie Jr. et al. 1987; Wells et al. 2003; Pípalova 2006; Cudmore and Mandrak 2004; Bozkurt et al. 2017).

Through the literature, this chapter will give a short review about the evaluation of the grass crap in monitoring the aquatic plants in the freshwater systems and itemises the effects and harm that this species can bring to the freshwater habitats (Leslie Jr. et al. 1987; Wells et al. 2003; Pípalova 2006; Cudmore and Mandrak 2004; Bozkurt et al. 2017).

The information given in this chapter is arranged in five sections. In the first section, general information about the grass is given, in the second section, possibility of using grass carp in controlling aquatic vegetation, in the third section, the influences of grass carp on the habitats and biota of the freshwater systems, in the fourth section, the status of grass carp in Iraq is reviewed from the point of view of its biology and establishment in the Iraqi inland waters and finally, in the fifth section, recommendations are given to guide policymakers in countries like Iraq in planning the control of his species (Wells et al. 2003; Cudmore and Mandrak 2004).

38.2 General Information about the Grass Carp

38.2.1 Identification and Short Description

Since it has been described by Valenciennes in 1844 as *Leuciscus idella*, *Ctenopharyngodon idella* is used to be included within the family Cyprinidae. Recently, the phylogenetics of the family Cyprinidae has been revised and some of the subfamilies have been upgraded to the family level. Now, *C. idella* belongs to the new family Xenocyprididae (Pípalova 2006; Chen and Mayden 2009; Stout et al. 2016; Bozkurt et al. 2017).

The grass carp (Fig. 38.1) is large size species and the genus *Ctenopharyngodon* contains only one species (Page and Burr 1991; Chilton III and Muoneke 1992; Billard 1997). This species has the following set of characters: head broad with no scales; mouth located below short snout provided with thin lips and absence of

Fig. 38.1 *Ctenopharyngodon idella*, collected from Shatt al-Arab River, Basrah, Iraq. Courtesy of Mustafa al-Mukhtar, Marine Science Centre, University of Basrah, Iraq

barbels. Body is slim and reasonably compacted with a curved belly and marginally curved lateral line, reaching the middle of the depth of the tail (Skelton 1993; Opuszynski and Shireman 1995; Pípalova 2006; Stout et al. 2016). No spines are present in fins. Body is with dusky grey on the upper part and brighter on the lower, with shade of shiny golden colour (Page and Burr 1991; Billard 1997). This species reaches maximum length of 1500 mm total length (Billard 1997) and reaches a maximum weight of 45 Kg (Skelton 1993; Opuszynski and Shireman 1995; Pípalova 2006; Stout et al. 2016).

38.2.2 Distribution

Grass carp inhabits sub-tropical to temperate regions and natural to large rivers and lakes in eastern Asia. There is a broad range of climatic conditions within the native range of the grass carp and it has been extensively introduced (mainly for macrophyte control) to several countries around the world (Pípalova 2006; Bozkurt et al. 2017).

38.2.3 Biology of the Grass Carp

38.2.3.1 Age and Growth

The life duration of the grass carp in its native country is 11 years, while scales of this species showed various individuals in their 15 years of age (Shireman and Smith 1983). Several factors that affect the growth in this species are feeding, temperature and oxygen (Chilton III and Muoneke 1992; Pípalova 2006; Bozkurt et al. 2017).

38.2.4 Tolerances

Grass carp is of those freshwater species that can tolerate variation in the environmental factors such as water temperature (Federenko and Fraser 1978). On the other hand, factors like variation in dissolved oxygen could initiate stress and Young individuals could face variation in oxygen level in the range of 0.41 to 28 mg/l (Meyer et al. 1975; Shireman and Smith 1983; Pípalova 2006; Bozkurt et al. 2017). Individuals of grass carp could endure salinities of 11 to 12 parts per thousand (ppt) and up to 19 ppt for brief periods (Meyer et al. 1975).

38.2.4.1 Reproductive Biology

Age of maturity depends on the water temperature and obtainable high value diet (Stanely et al. 1978). Developed grass carp needs about 1500 to 2000 degree days within a year for gonadal progress and maturation (Shireman and Smith 1983, Beck 1996; Pípalova 2006). When mature, the individuals of this species reach total length of nearly 50-86 cm, with males reaching maturity before females (Bozkurt et al. 2017).

With the mature individuals, it is possible to separate males and females as the formers have tubercles on the dorsal and medial surfaces of the pectoral fins (Shireman and Smith 1983). On the other hand, deciduous scales are shown in females (Beck 1996; Bozkurt et al. 2017).

Water temperature factor is considered the onset factor in persuading spawning and differs with areas. This species is characterised in several spawning seasons (Shireman and Smith 1983; Beck 1996; Pípalova 2006).

Grass carp prefers to put their eggs in the main branches of rivers during high water (Shireman and Smith 1983; Beck 1996; Pípalova 2006; Bozkurt et al. 2017). Spring to summer is the period chosen by this species for spawning (Shireman and Smith 1983). Individuals usually chose their habitats for laying eggs in turbid, turbulent water at the convergence of rivers or below dams (Federenko and Fraser 1978; Stanely et al. 1978; Bozkurt et al. 2017). In spawning locality, females are frequently more than males by about two to one. For fertilisation of the eggs, each female is regularly trailed by two or more males.

The number of eggs is related to the length, weight and age and ranges from 0.001 to two million eggs, but commonly with mean of 0.5 million for a 5 kg brood stock (Shireman and Smith 1983, Chilton III and Muoneke 1992; Bozkurt et al. 2017). The eggs are 2.0-2.5 mm in diameter when out, but rapidly swell to a diameter of 5-6 mm with absorption of water (from Chilton III and Muoneke 1992). They are semi-buoyant and non-adhesive, requiring water with high oxygen level to assist in their suspension in the water column before hatching (Stanely et al. 1978, Chilton III and Muoneke 1992; Bozkurt et al. 2017).

38.2.4.2 Food and Feeding Habit

There are several factors that may affect the feeding ecology of this species such as age, size, temperature, availability of specific food, depth and density (in pond cultures) (Opuszynski and Shireman 1995). Rigorous feeding occurs precisely when water temperature is at least 20 °C (NatureServe 2003; Pípalova 2006; Bozkurt et al. 2017). Opuszynski and Shireman (1995) have suggested that young individuals immediately after hatching feed on rotifers and protozoans and then with their development, change to larger cladocerans. At the age of 6 months they start to feed on large objects such as *Daphnia* and insect larvae. Later, they feed on plant items more than animal including filamentous algae and macrophytes and they divert to feed on a limited macrophyte when they reach 1 to 1.5 months after hatching (Pípalova 2006; Bozkurt et al. 2017).

Adult grass carps are discriminating in their selection of particular plant species favouring underwater plants with soft leaves (Bailey and Boyd 1971; Pine and Anderson 1991; Bozkurt et al. 2017) and eating the most favoured species first until they become uncommon (Bailey and Boyd 1971; Pípalova 2006; Bozkurt et al. 2017). Less favourite plant species like filamentous algae and firmer-leaved macrophytes are eaten when they are the only species available (Pine and Anderson 1991; Opuszynski and Shireman 1995). Adult individuals of this species can switch to other food items once their favourite food objects become rare (Bailey and Boyd 1971; NatureServe 2003; Pípalova 2006; Bozkurt et al. 2017). The adults of this species also appear to have in their stomachs parts of tree leaves and twigs from banks (Bailey and Boyd 1971; Pine and Anderson 1991; Bozkurt et al. 2017). Such feeding behaviour shows that they inclined to feed on non-aquatic plant objects in the case of lack of submerged plants.

38.3 The Possibility of Using Grass Carp in Controlling Aquatic Vegetation

Plants that inhabit water are important and play a significant role in the freshwater habitats. They contribute noteworthily in energy storing. Furthermore, they act as protection and reproduction sanctuaries for many creatures, and their submerged fragments permit the growth of periphyton groups (Pitelli 1998; Pípalova 2006; Bozkurt et al. 2017).

On the other hand, and in addition to their high benefit, they could simply overgrow and convert to a source of aggravation to the landlord. They easily can destruct the fishing prospective of the water body. The accumulation of a dead plants in any water body could decrease the level of oxygen, which in turn can bring damage to other creatures living in the same environment (Pitelli 1998; Pípalova 2006; Bozkurt et al. 2017).

Monitoring and eradicating aquatic plants from any freshwater system are often unclear and unsatisfying jobs. The choice of a vegetation management plan depends on local settings of the water body (Pitelli 1998). Therefore, there are three approaches that can be followed to get rid of the over-grown macrophytes; these are: mechanical, chemical and biological control. The mechanical control, which involves physical removal of the vegetation and is often more difficult in water than on land, the chemical vegetation control is often unsuccessful, and retreatment may be needed. Biological control has many advantages over the other vegetation control means. For instance, it takes much less human work effort than most of the mechanical control means and does not require using expensive and hazardous aquatic herbicides. In addition, using fish species provides longer-term control than other control mechanisms due to fishes that usually have a lifespan of several years (Pitelli 1998; Zweerde 1990; Pípalova 2006; Bozkurt et al. 2017).

Among fish species that are used to manage the overgrowth of aquatic plants are some species of tilapia (*Tilapia* spp.), silver carp (*Hypophthalmichthys molitrix*) and the grass carp (*Ctenopharyngodon idella*). Among those species, grass carp is the only one to eat large amount of plants (Cross 1969; Zweerde 1990). It has been shown that in some cases, adult individuals of this species can eat more than its own weight of plant material on a day-to-day basis (Cross 1969; Zweerde 1990; Pípalova 2006; Bozkurt et al. 2017).

In order to use grass carp as a method to eradicate vegetation from a freshwater body system, Bozkurt et al. (2017) have suggested the following points that need to be considered in such a process; they wrote the following:

38.4 Stocking of Grass Carp for Controlling Aquatic Vegetation

To manage the overgrowth of the aquatic plants, it is significant to know beforehand the amount of plant groups, plant types, water body sizes and the size of fishes stocked. Then, the number of individuals of grass carp can be made available for this process (Blackwell and Murphy 1996; Pípalova 2006).

Different methods have been used to determine the suitable number of grass carp to stock. The most precise method is to determine the weight of aquatic vegetation in the freshwater body, knowing the ingesting rates of the fish (Blackwell and Murphy 1996; Pípalova 2006).

Despite the studies' investigation on diverse stocking proportions, there is no recommendation that is satisfactory to all circumstances for grass carp. Each aquatic system is dissimilar due to its particular features of fertility, water clarity, shallow water and chemical makeup (Blackwell and Murphy 1996). So, each of these means disturbs the number of grass carp necessary to attain the plant level to the anticipated management level. Supplying rates with individuals of grass carp could show variation ranging between one fish and as many as 20 per acre, liable on the quantity and types of aquatic plants (Adamek et al. 2003; Pípalova 2006).

Supplying rates with individuals of grass carp need to be increased as temperature decreases as grass carp plant ingests and growth reduces. Supplying bulks need to be grounded on the standing crop (biomass) of aquatic plants. This is assessed by multiplying plant distribution by average plant density; consequently, the higher the vegetation biomass, the higher the necessary stocking rate (Blackwell and Murphy 1996; Pípalova 2006).

It has to be noted before the stocking of grass carp started that overstocking will lead to an entire elimination of all aquatic plants, while understocking process will result in a discriminating decrease of aquatic plants (Blackwell and Murphy 1996; Adamek et al. 2003; Pípalova 2006).

It is important to know that grass carp age and size are also significant owing to the conceivable predation on them, which can distinctly reduce their early stocking density. Grass carp should be larger than 30 cm when supplied; elsewhere, they are very susceptible to predators (Adamek et al. 2003).

38.5 Changes in Aquatic Plant Pattern and Plankton Composition

Grass carp can endlessly impact preferred aquatic plant species. Such influences have been noticed for 15–20 years at higher stocking rates. It is presumed that removal of aquatic vegetation favoured by the grass carp leads to decrease of the variety of aquatic macrophyte groups (Richard et al. 1985; Catarino et al. 1997; Bozkurt et al. 2017).

Supplying of grass carp individual density and organised plant area disturbs the expansion of phytoplankton assembly in the freshwater body of any sort. In the case of slow handling of plants by grass carp, the subsidiary effects of grass carp stocking on phytoplankton are trivial (Catarino et al. 1997; Pípalova 2006; Bozkurt et al. 2017).

Primary production of the water body relies on two factors, light and nutrient obtainability. These two issues upset unbalanced equilibrium between macrophytes and phytoplankton. Therefore, the speed and degree of macrophyte elimination by the grass carp disturb the phytoplankton production (Richard et al. 1985; Catarino et al. 1997).

Zooplankton consumption is essential for juvenile and adult grass carp; nonetheless, the injected quantities are minor in case the stocking density is not extremely high (Terrell J W and Terrell 1975). Changes in zooplankton wealth and community structure were owing to an upsurge in phytoplankton and changes in planktivore predation on zooplankton by fish after macrophyte elimination (Richard et al. 1985; Pípalova 2006; Bozkurt et al. 2017).

38.6 Changes in Water Quality and Benthos

The influences of grass carp on plants and water quality are highly flexible and frequently doubtful owing to the lack of appropriate management locations. The amount and rate of plant elimination by the grass carp are imperative. Variations in water quality as a result of plant exclusion by the grass carp frequently happen in minor, non-flowing water bodies and least found when only a small quantity of plants is detached from large, comparatively deep, flowing reservoirs. So that, reductions could be witnessed in oxygen concentration of water subsequent to grass carp supplying, depending on the vanishing of macrophytes (Opuszynski

1972; Pípalova 2006; Bozkurt et al. 2017). Primary producers such as phytoplankton and aquatic macrophytes not only provide oxygen, but also use CO2 during photosynthesis, which outcomes in an upsurge in water pH. Fluctuations in oxygen concentrations subsequent to grass carp supplying were certainly linked with the variations in pH (Opuszynski 1972; Gasaway 1979; Leslie et al. 1983; Pípalova 2006; Bozkurt et al. 2017).

Greater supplying quantities of grass carp or their lengthier effect can upsurge concentrations of nutrients in the water, but this growth chiefly relies on the water-body features (Gasaway 1979; Opuszynski 1972; Pípalova 2006; Bozkurt et al. 2017). These variations outcome from sediment resuspension throughout feeding and faecal matter deposition by carp as well as failure of systems accountable for upkeep of the vegetated state owing to elimination of macrophytes. Alterations in benthos agreed closely with variations in aquatic plants, which alleviate sediments and deliver extra substrate in the shape of root masses and rotten material. Zoobenthos also reacted to deviations in water quality subsequent to the elimination of aquatic macrophytes (Gasaway 1979).

38.7 The Effects of Grass Carp on the Environment and Biota of the Freshwater Systems

Nevertheless, the collective usage of grass carp (*Ctenopharyngodon idella*) as a biocontrol mediator affects aquatic macrophytes and there has been inevitability about the ecological danger it poses to the ecosystems in some parts of the world (Wittmann et al. 2014; Pípalova 2006; Bozkurt et al. 2017).

Wittmann et al. (2014) re-assessed the ecological threat of grass carp by means of efficient data and prediction tackles. They utilised first questionnaire, where they intend to comprehend whether the fishery specialists in the area where they are performing their assessment discriminate that grass carp generates ecological damage to the area. Second, they compute conceivable ecological danger by means of new investigation tools (eDNA).

The followings are the chief impacts of grass carp on the habitats of the freshwater system and its biota:

38.7.1 Effects on the Sediment Chemistry

In the water system, where grass carp individuals were stocked, the food items from macrophytes were stuck into the sediment (precipitated either by or with organic acids) and consequently were not obtainable to phytoplankton (Terrell 1975; Hestand and Carter 1978; Pípalova 2006; Bozkurt et al. 2017).

38.7.2 Effects on Phytoplankton

Phytoplankton production can be impacted by both the supplying density of grass carp and area of weeds managed. This influence will be insignificant if weed manipulation by grass carp is slow and some aquatic macrophytes are left in a water body. At a low supplying density, divergences in the concentration of chlorophyll-a in the water were trivial (Holdren and Porter 1986; Pípalova 2006; Bozkurt et al. 2017). Though, a high supplying density of grass carp, which can remove all aquatic macrophytes and the nutrients' unconfined yields, augmented phytoplankton**.** The result of such covering outcome of higher phytoplankton biomass and outstanding aquatic macrophytes are frequently further inhibited. Consequently, wind act can also upsurge water turbidity due to sediment transfer, particularly in the shallow water bodies (Pípalova 2006).

Removal of macrophytes augmented blue-green algae richness in the phytoplankton groups almost 9 times (Holdren and Porter 1986)**.** However, the blue-green algae ruled only during the peak phytoplankton season. Holdren and Porter (1986) stated changes in chief taxa and relative abundances of green and blue-green algae and diatoms, with a general swing to smaller species happening after grass carp supplying.

38.7.3 Effects on Zooplankton

Ingesting of zooplankton is fundamental for both juvenile and adult grass carp, but the quantities eaten are irrelevant if the supplying density is not very high (Terrell and Terrell 1975; Zhang and Chang 1994; Pípalova 2006; Bozkurt et al. 2017). Main influences on zooplankton incline to be ancillary. In lakes supplied with herbivorous fish, the growth of zooplankton and zoobenthos is enhanced through eating macrophytes by the fish and then augmented rates of nutrient remineralization. The entire result can also be inveterate in an upsurge of fish production (Zhang and Chang 1994; Pípalova 2006). Variations in zooplankton wealth and community structure were owing to an upsurge in phytoplankton and changes in planktivore predation on zooplankton by fish after macrophyte exclusion (Richard et al. 1985).

38.7.4 Effects on Zoobenthos

The process of feeding on zoobenthos by grass crap can affect the biomass of these organisms significantly (Terrell and Terrell 1975; Schramm Jr. and Jirka 1989; Bozkurt et al. 2017)**.** Variations in benthos are related mainly to fluctuations in aquatic plants (van der Zweerde 1982; Pípalova 2006), which ease sediments and offer extra substrate in the shape of root masses and decaying material (Schramm

Jr. and Jirka 1989). Zoobenthos also reacted to variations in water quality subsequent exclusion of aquatic macrophytes (Gasaway 1979; Schramm Jr. and Jirka 1989; Pípalova 2006; Bozkurt et al. 2017). It appears clear that the grass carp does not disturb zoobenthos straight. Ancillary variations at the primary level, i.e. phytoplankton, are still not properly enumerated and therefore, variations at the secondary level, i.e. zoobenthos, are not simple to demonstrate. The same looks true for fluctuations in zooplankton.

38.7.5 Effects on Fish Communities

The presence of grass carp for vegetation control decreases the spawning locations for phytophilous fish or lodgings for predatory fish and their prey. It can also incidentally influence the life of some other fish that is dependent on phytophilous animals (Bettoli et al. 1993; Pípalova 2006; Bozkurt et al. 2017).

Food fight between grass carp and other fish can occur in natural water bodies when aquatic macrophytes are detached. In pond polyculture, grass carp prefers commercial food to aquatic plants, which causes competition and decreased growth with common carp (*Cyprinus carpio* L.) (Krupauer 1968). Certain fish species augmented growth, production and survival in the presence of grass carp due to the augmented food supply because of the increased planktonivorous fish (Bettoli et al. 1993; Pípalova 2006; Bozkurt et al. 2017) or because of the fish feeding on faecal pellets (Krupauer 1968; Takamura et al. 1993; Bozkurt et al. 2017). Takamura et al. (1993) proposed that planktonivorous fish did not exploit the faeces of grass carp, but use the involved nutritive microorganisms, which are too small to be eaten directly.

Macrophytes assist as a spawning ground (especially for phytophilous fish species), food (phytophilous animals attached to them) and housing for fish. The number of mainly phytophilous fish species decreased when plants were totally eradicated or their biomass reduced significantly (Krupauer 1968; Takamura et al. 1993; Pípalova 2006; Bozkurt et al. 2017).

38.7.6 Effects on Amphibian and Water Bird Communities

Use of grass carp to control nuisance aquatic plants may reduce environment superiority for waterfowl mainly for the food materials of the grass carp and some species of water birds overlay (Benedict and Hepp 2000; Pípalova 2006).

38.7.7 Effects on Aquatic Macrophyte Community

Plant species succession usually happens when an aquatic plant is eaten from a certain place. The newly comers of plant species must have features to face the grazing impact and its extent.

It is presumed that the consequences of removal of aquatic plant species favoured by the grass carp or in contrary dispersion of disturbing alien species will be decrease of the variety of aquatic macrophyte groups (Catarino et al. 1997; Pípalova 2006).

Variety does indicate not only the number of species but also their relative abundance (biomass). Grass carp favoured the filamentous alga (*Cladophora*) to other macrophyte species and thus, it prohibited the filamentous algae from having massive growth in any aquatic habitat. The influence of the grass carp on variety in aquatic habitats can be influenced by the density and size of fish supplied, presence/absence of favoured and non-favoured species, length of fish effect and definitely on grass carp survival/movement from the system.

38.7.8 Effects on Eutrophication and Water Quality

About one half of the food materials in consumed by grass carp are utilised and digested, the remaining portion go out through the intestine as either partially assimilated or incompletely split material (Stanley 1974; Pípalova 2006).

Hydrochemistry is powerfully influenced by hydrology and morphology of water bodies and weather conditions and therefore, showing statistically important variations in water chemistry instigated by other factors (e.g. grass carp) is difficult. Water quality alteration as a consequence of plant elimination by the grass carp is most influenced in small, non-flowing water bodies and least affected when only small proportion of plants is detached from large, relatively deep, flowing reservoirs (Stanley 1974). The effects of grass carp on plants and water quality are highly adjustable and frequently indecisive due to the absence of proper management sites. The amount and rate of plant exclusion by the grass carp are critical. Higher supplying masses of grass carp or its longer influence can upsurge concentrations of nutrients (especially nitrogen and phosphorus) in the water, but these surges are mostly reliant on the water body features (Stanley 1974; Pípalova 2006).

38.8 Position of the Grass Carp in the Iraqi Inland Waters

In Iraq, the biological status of the grass is unknown, but what is known is that this species has invaded all the freshwater system in Iraq and replaces native fish species in their niches. All the research studies performed so far concentrate mainly on the influences of pollutants on the grass carp, some physiological aspects and breeding experiments. No studies have taken into consideration the impact of grass carp on the habitat or on the biota. Such unawareness will lead definitely to destroying of the freshwater environment including the biota living in.

38.8.1 Recommendations for Management of Stocking and Release of Grass Carp

The following general recommendations are set and so the countries like Iraq can adopt to solve the problem of releasing and culturing grass crap in the inland waters. Such practices are going on in Iraq without any inspection and without any licencing. Policymakers in Iraq in regard to the freshwater fish economy should take a genuine step in the track of supporting the declining freshwater environment in Iraq and solve the problems that the invasive species such the different species carp has created.

1. It is necessary to continue evaluating and update ecological hazard to develop the welfares of introduced species while dropping down unsolicited presence and impacts.
2. It may be recommended that careful evaluation is made to assess the effective uses of the species as a biological weed controller in any freshwater system against the probable impact to the lives of native freshwater species.
3. Investigations of the relationship between the addition of large amounts of undigested faeces and eutrophication should also be made.
4. 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.
5. Barriers need to be located crossways along the emergency spillways (i.e. canals, culverts, etc.) before grass carp can be supplied into any freshwater habitat. Branches and canals of the water body need to be stocked with grass carp need to be supplied with barriers that contain net to stop grass carp from jumping as this species is very good at jumping.
6. Initial valuation of the influence needs to go outside the foundation for introducing exotic species to deliberate influence on aquatic ecology, generally, the consequence on food fishes, on waterfowl and on aquatic plants, the catchability and edibility of the species and the implication to public health**.** For this purpose, it may be more instructive to study a species that has already been introduced and established in its non-native environment. The species should be well known biologically in its native land.
7. The subject management of the grass carp should be publicised in appropriate newspapers, newsletters, magazines and journals and expert advice should be welcomed. No importation of a species for release purpose is so urgent that its biological implications should not be severely reviewed by a broad panel of experts from representative government and public agencies.

8. The research report should be publicised and an evaluation should be made by a panel of representatives from all involved country agencies together with scientists recommended by a national society or governmental universities. Because animals do not follow political borders, it would seem that regional agencies should be involved at the start.

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