

## GRASS CARP FOR AUSTRALIA—A FISHERIES VIEWPOINT

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### ABSTRACT

The aims of this paper are to summarize the history of fish introductions into Australia; to describe in general terms the attitude of Australian fisheries authorities to further introductions; and to outline current procedures for seeking approval to introduce a new species of fish to Australia. No attempt has been made to review the extensive literature on grass carp, *Ctenopharyngodon idella* Val.

The views expressed in this paper reflect the attitudes of fisheries agencies in Australia, but should not be taken as an official statement of either Federal or State Government policy.

### INTRODUCTION

The possibility of introducing grass carp, *Ctenopharyngodon idella* Val. (Cypriniformes: Cyprinidae), to Australia as a possible control agent for aquatic weeds, has not yet been given any serious consideration by the relevant authorities in this country. Responsibility for mechanical and chemical control of aquatic weeds in Australia rests primarily with the relevant State Government agencies, and for biological control with the *Commonwealth Scientific and Industrial Research Organization* (C.S.I.R.O.). Difficulties have arisen in the past with co-ordination of the action required to control severe outbreaks of problem aquatic plants, and there have been recent discussions on the possibility of developing a national approach to the management and control of aquatic weeds.

I was invited to participate in these discussions, as the representative of the Australian Fisheries Council, when the use of herbivorous fishes (particularly grass carp) was being considered as a possible alternative to methods currently in use or under consideration.

Although it is not possible at this stage to record the official viewpoints of either State or Federal fisheries authorities, I am confident that the information given in this paper can be regarded as being representative of the general feeling of fisheries authorities in this country.

### FISH INTRODUCTIONS INTO AUSTRALIA

#### Deliberate introductions

Since European settlement commenced early last century, at least 24 species of freshwater fishes have been introduced into, and have become established in, the freshwaters of Australia. Many of these introductions were made in the latter half of the last century, by people who apparently believed that the local fish fauna could be enhanced by the introduction of fishes that were regarded at the time as desirable angling and food species in England. Most of the effort involved in these early introductions was supplied by enthusiastic individuals and Acclimatization Societies, primarily in the southern States of New South Wales, Victoria and Tasmania. This effort was rewarded by almost complete success, as all of the species involved soon became established in the wild and are now widespread throughout the country. The successful introductions were, in approximate date order of arrival:

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Brown trout	<i>Salmon trutta</i> Linn.	(Salmoniformes:Salmonidae)
English perch (redfin)	<i>Perca fluviatilis</i> Linn.	(Perciformes:Percidae)
Tench	<i>Tinca tinca</i> Linn.	(Cypriniformes:Cyprinidae)
Roach	<i>Rutilus rutilus</i> Linn.	(Cypriniformes:Cyprinidae)
Goldfish	<i>Carassius auratus</i> Linn.	(Cypriniformes:Cyprinidae)
Crucian carp	<i>Carassius carassius</i> Linn.	(Cypriniformes:Cyprinidae)
Rainbow trout	<i>Salmo gairdneri</i> Linn.	(Salmoniformes:Salmonidae)
Common carp	<i>Cyprinus carpio</i> Linn.	(Cypriniformes:Cyprinidae)

Since these early years, there has been a number of deliberate introductions of new fish species, at least two of which, the mosquito fishes *Gambusia* spp. (Cyprinodontiformes:Poeciliidae), have become well established and widespread in many areas of Australia. These fishes were first introduced in the 1920s and again in the 1940s, apparently with the hope that they would effect some degree of control over mosquitoes in inland waters (Wharton 1977).

The brook trout *Salvelinus fontinalis* Mitchill (Salmoniformes:Salmonidae) has been stocked in selected waters in New South Wales and Tasmania, but information on the viability of the resultant fish populations is not conclusive at the present time. The Atlantic salmon *Salmo salar* Linn. (Salmoniformes:Salmonidae) and the Chinook salmon *Onchorynchus tshawytscha* Walbaum (Salmoniformes:Salmonidae) have been stocked in selected waters in New South Wales and Victoria, respectively, but neither species has become established as a viable population. It is interesting to note that the initiatives in relation to these three salmonid fishes were taken by State Government fisheries agencies, who expend considerable sums of money maintaining brood stock in hatcheries. The motivation in each case was to provide additional fishing opportunities for recreational anglers in the three States concerned.

#### Accidental introductions

In addition to the deliberate introductions mentioned above, a number of tropical aquarium fishes have apparently escaped from captivity and have established breeding populations at several localities in Queensland and at one locality in Victoria.

McKay (1977 and pers. comm.) has reported the presence of breeding populations of at least eight species of tropical fishes in Queensland's inland waters. They include the guppy, *Poecilia reticulata* Peters. (Cyprinodontiformes:Poeciliidae), the platy and swordtail, *Xiphophorus* spp. (Cyprinodontiformes:Poeciliidae), two species of molly, *Mollienisia* spp. (Cyprinodontiformes:Poeciliidae), the rosy barb *Puntius conchonius* Ham. Buch. (Cypriniformes:Cyprinidae), and two species of Tilapia, *Tilapia* spp. (Perciformes:Cichlidae).

Cadwallader *et al.* (1980) reports the presence of breeding populations of three cichlid fishes in the Hazelwood Power Station cooling pond in Gippsland, Victoria. They are the convict cichlid, *Cichlasoma nigrofasciatum* Guenther (Perciformes:Cichlidae), the Jack Dempsey cichlid, *Cichlasoma octofasciatum* Regan (Perciformes:Cichlidae), and the Niger cichlid, *Tilapia mariae* Bouleng. (Perciformes:Cichlidae).

It is relevant at this juncture to outline the present situation in relation to importation of tropical aquarium fishes into Australia. In 1963, the Advisory

Committee on the Importation of live Aquarium Fishes (acting for the Commonwealth/State Fisheries Conference) produced an 'Alphabetical List of Exotic and Indigenous Aquarium Fishes'. This document identified four categories of aquarium fishes:

Category A	—	Importation prohibited
Category B	—	Importation approved
Category C	—	Importation prohibited pending investigation
Category D	—	Importation approved subject to review; to be prohibited from entry if subsequent home or overseas reports are unfavourable.

The List was published by the Fisheries Division, Department of Primary Industry, Canberra in the same year, and it (together with two addendum sheets subsequently issued) now constitutes the official list of fishes that may (*ca.* 700 species) or may not (*ca.* 100 species) be imported into Australia (McKay 1977). In addition, it should be noted that fishes not mentioned in the Alphabetical List (apart from marine species) are automatically classified as prohibited imports. Persons wishing to import marine aquarium fishes may seek specific approvals from the Federal Minister responsible for Customs, and several hundred such approvals have been granted. Approved shipments of aquarium fishes are subjected to quarantine and customs inspection at the point of entry into Australia, ostensibly to ensure that prohibited fish, aquatic plants and other organisms do not gain entry to the country, either by accident or by design. It is generally accepted that the present system is far from ideal, and several proposals for a more effective screening of incoming consignments are under consideration.

#### ATTITUDES TOWARDS NEW FISH INTRODUCTIONS

Live fish and the spawn thereof are prohibited imports under Item 23(a) of the Second Schedule to the Customs (Prohibited Imports) Regulations, and may be imported into Australia only with the approval of the Federal Minister for Business and Consumer Affairs—the Minister responsible for Customs and Excise matters. The Minister has accepted the recommendation made by the Advisory Committee mentioned earlier, and it follows that the only fishes that may legally enter Australia are those specified in the Alphabetical List mentioned earlier, together with marine aquarium fishes that have been individually authorized (approx. 200 species) by the Minister from time to time.

Responsibility for co-ordination and documentation of the overall attitude of fisheries administrations towards importation of fish now rests with the 'Advisory Committee on Endangered Species and Import and Export of Live Fish' (referred to hereafter as the Advisory Committee). This group reports to the Standing Committee of Fisheries, which in turn reports to the Australian Fisheries Council. The compositions of these three important fisheries bodies are outlined in Appendix I, together with details of the States and Federal Agencies responsible for fisheries.

As its name implies, the 'Advisory Committee' has very broad terms of reference, and much of its work in recent years has been associated with proposed amendments to the 1963 'Alphabetical List'. In this regard, the 'Advisory Committee' is currently considering a reduction in the numbers of aquarium fishes approved for importation into Australia. This action was prompted by several considerations, including the risk of disease entry with

imported fishes, the relative infrequency of importation of some approved species, and the likelihood that some approved species could be bred and reared economically in Australia.

Predictably, the 'Advisory Committee's' proposals have met with some considerable opposition from the substantial and profitable aquarium fish industry in Australia, and the matter has not yet been resolved to the satisfaction of either party.

Apart from its deliberations on importation of aquarium fishes, the 'Advisory Committee' has from time to time received proposals to import other fishes. By far the most significant was a proposal from Queensland authorities to import the Nile perch, *Lates niloticus* Linn. (Perciformes:Centropomidae). The original proposal (J.C.F. Wharton, Fisheries and Wildlife Division, pers. comm.) was made about 10 years ago, and since then the Advisory Committee has sought and obtained a large amount of biological information on the species and on the barramundi, *Lates calcarifer* Bloch (Perciformes:Centropomidae). The latter is an Indo-Pacific species which occurs in coastal rivers in the northern half of Australia, and whose existence was thought to be threatened by plans to build substantial impoundments on these rivers. The Nile perch was to be brought in to compensate for this loss as this species, unlike the barramundi, can maintain breeding populations in fresh water. It is probably true to say that almost all of the biological data available on both species had been considered by the Advisory Committee about two years ago, and a decision was not far off when the Queensland State Authority withdrew its application.

The attitude of Australian fisheries authorities towards new fish introductions could well be described as one of extreme caution, and is undoubtedly based on a number of factual observations.

Firstly, as pointed out by McKay (1977), Australia has a depauperate freshwater fish fauna and a 'permissive' freshwater habitat. This situation has arisen because of Australia's geographic isolation from the vast freshwater fish faunas of south-east Asia, South America and Africa. He quotes Courtenay *et al* (1974) who maintain that 'permissive habitats (those not fully occupied with regard to trophic levels and species niche concepts) and weakened environments (these altered naturally or by man) are particularly susceptible to establishment of non-indigenous exotic species'. The Australian experience certainly seems to underline the validity of this observation. As mentioned earlier in this paper, virtually all the species that were deliberately introduced to this country have thrived in their new environment. Some, such as tench and roach, have proved to be of no real value and have probably had little impact on the aquatic habitat and its associated flora and fauna. Others, such as the trouts and redfin, are now regarded by many as essential components of our freshwater fish fauna, but there is widespread acceptance of the view that these fishes have, in certain areas at least, had a severe impact on the local fish fauna. The rapid spread of common carp, from Gippsland, Victoria, in the early 1960s to most of the Murray/Darling river system and other waters in Victoria, New South Wales and South Australia affords a striking and contemporary example of what can happen when a new fish species is introduced to a 'permissive' habitat. Although opinions on the real impact of common carp differ to some degree, the success of this fish in colonizing our inland waters is beyond dispute.

Secondly, there is the observation that no one can predict with certainty what will happen when an exotic animal is introduced to a new environment. The lessons learned with a wide variety of animals in many countries are clearly

evident, and it is entirely understandable and eminently desirable that Australia should learn from the unfortunate experiences of other countries. This is not to say that proposals for new introductions should not be entertained as there are many examples of introductions that achieved the desired result with few, if any, undesirable and possibly unforeseen consequences.

Thirdly, all proposals to introduce an exotic species carry an inbuilt risk of introducing disease organisms and parasites not present in the local environment. Although the addition of stringent precautions can certainly minimize this risk, it should be remembered that Australia is indeed fortunate to be free of many of the world's most important and devastating fish diseases. One obvious way of minimizing the disease risk associated with introduction of a new fish species is to import viable ova, which can be virtually guaranteed to be free of parasitic infestations and can be certified to be free of bacterial and virus diseases with varying degrees of confidence. In the case of grass carp, the eggs of which have a very short hatching period, this procedure may be difficult to implement. Edwards and Hine (1974) reported that grass carp fry imported into New Zealand from Hong Kong suffered very high losses from the effects of a range of disease and parasitic organisms that accompanied them from their place of origin.

Finally, proposals to introduce a new species for the purpose of biological control may appear to offer, at least to the casual or poorly informed observer, a simple, efficient, permanent and relatively inexpensive solution to the problem. Such an attitude is unlikely to be found amongst the ranks of professional experts in the field of pest control but it would be dangerous to assume that it could not develop among members of the public at large and even in political circles. In the face of an immediate and substantial problem, with very real implications for people and their livelihoods, it is not inconceivable that such an attitude might prevail despite the reservations of more informed people with concern for the longer term. What is of course needed is a thorough and impartial analysis of all the available alternatives, their chances of success, the risks associated therewith, and comparative cost/benefit data for both the short and long term.

In summary, Australia's fisheries authorities can be expected to view any new proposals for introduction of exotic fishes with extreme caution. The reasons given above for this attitude will no doubt be readily understood and accepted by those whose long-term interests lie with the quality and stability of Australia's aquatic environment. If the possibility of introducing grass carp to control aquatic weeds in Australia becomes something more than an item for general discussion, those interested in pursuing the proposal would be well advised to follow the procedures outlined in the following section.

#### **PROCEDURES FOR SEEKING APPROVAL TO IMPORT A NEW FISH SPECIES**

At the present time, all applications for approval to import live fishes will be considered in the first instance by the 'Advisory Committee' referred to earlier in the paper. Although the Committee has not published formal guidelines, it should be clearly evident that serious consideration will only be given to fully documented applications. The composition of the Committee and the location of its secretariat will vary with time, but contact with the Committee can always be made through either Federal or State Government fisheries agencies.

The question of what might constitute a fully documented application can best be answered by identifying those aspects which would clearly be of concern to Australian fisheries authorities.

Firstly, the proponents should bring together all available information on the biology and behaviour of the fish, with the aim of allowing the best possible assessment of its probable impact on the Australian environment. This task is no more than a desk study and comprehensive review of the relevant literature, although in the case of grass carp the task could well be a major one. Wharton (1979) has pointed out that much of the information available on this species is contradictory and inconclusive, particularly in relation to food preferences, feed conversion efficiency, stimulation of phytoplankton and algal growth, utilization of algae, and effect on water quality especially in relation to nutrient levels.

Unfortunately, there is little chance that overseas data will be of any use in predicting the likely effects of grass carp on the reproduction, survival and growth of Australian native fishes in view of the uniqueness of the fish fauna of this country.

Secondly, the proponents should prepare a comprehensive and detailed analysis of all available alternatives to the use of grass carp for aquatic weed control. This analysis should embrace their chances of success, the risks associated with each, and comparative cost/benefit data for both the short and long term. The need for a clear definition of the perceived problem is self-evident.

Thirdly, the proponent should address the question of what further studies would be possible in the event that the results of the above investigations proved encouraging. At the very least, they would need to include extensive field testing in a 'fail-safe' area, where fish could not be removed and any accidental escapees would have no possibility of finding their way into a natural waterway. In the field situation, the potential competition between various ages and sizes of grass carp and the many Australian species of fish with which it may come into contact if released in the wild would have to be studied intensively. Similarly, the effectiveness of grass carp in controlling problem aquatic plants under Australian conditions would need to be carefully assessed. In addition, the parasite and disease status of the fish would have to be very thoroughly investigated.

Finally, as pointed out by Fedorenko and Fraser (1978), there are four basic criteria that should be met before an introduced biological control agent can be judged successful:

- 1) that it be effective on the target species;
- 2) that its numbers be controllable;
- 3) that it be readily containable within the affected area; and
- 4) that it coexist with native species without detriment to them.

Although Australian fisheries authorities may not entirely agree with this philosophy there is little doubt that questions along similar lines would have to be answered in detail before the 'Advisory Committee' would consider recommending to the Standing Committee on Fisheries that grass carp should be introduced into Australia. Looking well into the future, such a recommendation might then pass to the Australian Fisheries Council. If endorsed by that body, a final decision would be made by the Federal agencies responsible for Health and Customs matters, in consultation with the Federal Department of Science and the Environment.

## REFERENCES

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## APPENDIX I. AUSTRALIAN FISHERIES AUTHORITIES

Commonwealth (Federal)	Agency:	First Assistant Secretary <sup>1</sup> Fisheries Division Department of Primary Industry Canberra, A.C.T. 2600
	Minister:	Minister for Primary Industry
New South Wales	Agency:	Director of Fisheries <sup>1</sup> N.S.W. State Fisheries 211 Kent Street Sydney, N.S.W. 2000
	Minister:	Minister for Agriculture <sup>2</sup>
Northern Territory	Agency:	Director of Fisheries Fisheries Division P.O. Box 5160 Darwin, N.T. 5794
	Parent agency:	Department of Primary Production
	Minister:	Minister for Primary Production and Tourism <sup>2</sup>

## Appendix 1 (cont.)

Queensland	Agency:	Director <sup>1</sup> Queensland Fisheries Service 138 Albert Street Brisbane, Qld. 4000
	Parent agency:	Department of Harbours and Marine
	Minister:	Minister for Maritime Services and Tourism <sup>2</sup>
South Australia	Agency:	Director <sup>1</sup> S.A. Department of Fisheries 25 Grenfell Street Adelaide, S.A. 5000
	Minister:	Minister for Fisheries <sup>2</sup>
Tasmania	Agency:	Chairman <sup>1</sup> Tasmanian Fisheries Development Authority G.P.O. Box 619F Hobart, Tas. 7001
	Minister:	Minister for Primary Industry <sup>2</sup>
Victoria	Agency:	Director of Fisheries and Wildlife <sup>1</sup> Fisheries and Wildlife Division 250 Victoria Parade East Melbourne, Vic. 3002
	Parent agency:	Ministry for Conservation
	Minister:	Minister for Conservation <sup>2</sup>
Western Australia	Agency:	Director <sup>1</sup> Department of Fisheries and Wildlife 108 Adelaide Terrace Perth, W.A. 6000
	Minister:	Minister for Fisheries and Wildlife <sup>2</sup>

**STANDING COMMITTEE ON FISHERIES**

Heads of agencies as shown above<sup>1</sup>

Northern Territory represented by the Deputy Secretary,  
Department of Primary Production

The Federal Department of Finance and the C.S.I.R.O. are  
also represented.

**AUSTRALIAN FISHERIES COUNCIL**

Federal and State Ministers as shown above<sup>2</sup>

Federal Minister for Science and the Environment.

<sup>1</sup> Heads of Agencies.

<sup>2</sup> Federal and State Ministers.