History, Status and Future of Common Carp (*Cyprinus carpio* L.) as an Exotic Species in Malawi

Summary Report of the Workshop
Sponsored by ICLARM/Malawi Department of Fisheries/
Department of Research and Environmental Affairs/
University of Malawi

12-13 September 1991
National Aquaculture Centre
Domasi, Malawi

Edited by

ORTON V. MSISKA
AND
BARRY A. COSTA-PIERCE

International Center for Living
Aquatic Resources Management

Malawi Department of Fisheries

Malawi Department of Research
and Environmental Affairs

History, Status and Future of Common Carp (*Cyprinus carpio* L.) as an Exotic Species in Malawi

Summary Report of the Workshop
Sponsored by ICLARM/Malawi Department of Fisheries/
Department of Research and Environmental Affairs/
University of Malawi

12-13 September 1991
National Aquaculture Centre
Domasi, Malawi

Edited by

ORTON V. MSISKA
AND
BARRY A. COSTA-PIERCE

International Center for Living
Aquatic Resources Management

Malawi Department of Fisheries

Malawi Department of Research
and Environmental Affairs

History, Status and Future of Common Carp (*Cyprinus carpio* L.) in Malawi as an Exotic Species

Summary Report of the Workshop
Sponsored by ICLARM/
Malawi Department of Fisheries/
Department of Research and Environmental Affairs/
University of Malawi, 12-13 September 1991
Domasi, Malawi

Edited by

O.V. Msiska
B.A. Costa-Pierce

ICLARM Conference Proceedings 40

1993

Printed in Manila, Philippines

Citation:
Msiska, O.V. and B.A. Costa-Pierce, Editors.
1993. History, status and future of common carp
(*Cyprinus carpio* L.) in Malawi. ICLARM Conf. Proc. 40, 27 p.

Cover: A young Malawian fish farmer displaying both mirror and scaled varieties of common carp from his pond. (Photo by Reg Noble)

ISSN 0115-4435
ISBN 971-8709-37-1

ICLARM Contribution No. 927

CONTENTS

FOREWORD

Inland aquaculture is underdeveloped in all regions of the world, especially in subSaharan Africa. One of the main reasons for this is that ideas and technologies have often been 'parachuted' into rural Africa by experts who have experience of aquaculture in other regions but lack adequate knowledge of the natural and social environment of African farmers and of the fish consumers.

Some of these foreign imports are exotic species. The introduction of common carp to Malaŵi, as part of a development assistance project, is a typical example. Such introductions have always been made with good intentions, but some have ignored the possible environmental consequences of what are nearly always irreversible experiments. Their legacies can last forever.

It is somewhat ironic that Malaŵi, which is a shining example to other countries in its recent avoidance of introductions of exotic species and in its development of legal instruments to protect its natural environment (particularly Lake Malaŵi), should be the location for a workshop on the pros and cons of the use of an exotic species in aquaculture - the common carp (*Cyprinus carpio*). However, it reflects great credit on Malaŵi, particularly on the Department of Fisheries of the Government of Malaŵi, that this complex topic should be debated openly and that the results should be reported. Such debates are rare, even in a world that is now far more environmentally aware than when the introductions in question were made.

It is hoped that this workshop, and these summary proceedings, will provide some useful information for the future planning of aquaculture development in Malaŵi and in neighboring countries, and some guidance on the issues that need to be addressed in similar controversies worldwide.

These issues are complex: Malaŵi's people need more fish and livelihood opportunities; aquaculture is little developed but seems theoretically possible; native species seem to have limited potential for aquaculture compared to exotics, although scores of native species have yet to be studied for their aquaculture potential; the time needed to develop farmable fish and farming systems is an important consideration; development needs are certain whereas environmental impacts of exotic species are speculative. When all these points are weighed in the context of limited scientific information and widely differing local, national, regional and international opinions, the route to a consensus is anything but simple.

What is certain is that all the organizations and individuals that participated in this workshop will continue to work for environmentally-friendly solutions to the problems associated with development. FAO and ICLARM are also working together to improve international codes of practice for fish introductions, so that it will be easier for such appraisals to be made *before* shipments are made.

These proceedings contain the outputs from working groups that were for and against the development of common carp farming in Malaŵi, and the workshop's

recommendations. Whatever actions are taken by the Government of Malaŵi on the 'carp question', the most fervent wish of all concerned is that the conservation and sustainable utilization of Lake Malaŵi and Malaŵi's other natural resources can be reconciled with development needs.

ROGER S.V. PULLIN
Director
Inland Aquatic Resource Systems Program
ICLARM

SYNOPSIS

This workshop was convened to debate the pros and cons of the further use of common carp (*Cyprinus carpio*) as a farmed species in Malaŵi, given that it is an exotic species that could have effects on Malaŵi's natural waterbodies and their biota, including the globally important Lake Malaŵi. The workshop consisted of review papers on common carp introductions to Malaŵi, government policy, common carp farming on estates and smallholdings, and criteria for choice of alternative native species for aquaculture. The summary proceedings consist of extended abstracts of these papers, together with reports from working groups that took positions for and against the further development of common carp farming in Malaŵi. The workshop participants numbered 20, comprising mainly scientists and administrators from Malaŵian institutions and a few foreign participants attached to externally funded projects in Malaŵi. Sixteen persons voted for discontinuation of common carp farming in Malaŵi. Two voted for its continuation and two abstained. These proceedings constitute an interesting example of a debate over conservation and development issues in aquaculture.

New Introductions of Common Carp (*Cyprinus carpio* L.) and Impacts on Indigenous Species with Reference to SubSaharan Africa[1,2]

B.A. COSTA-PIERCE[3], *ICLARM/GTZ Africa Aquaculture Project*
P.O. Box 229, Zomba, Malawi

J. MOREAU, *Laboratoire d'Ichtyologie Appliquée, Ecole Nationale Supérieure Agronomique de Toulouse (ENSAT), 145 avenue de Muret*
31076 Toulouse Cedex, France

R.S.V. PULLIN, *International Center for Living Aquatic Resources Management (ICLARM)*
MCPO Box 2631, 0718 Makati, Metro Manila, Philippines

Abstract

In subSaharan Africa, indigenous fish genetic resources are threatened from introductions of exotic species. The World Conservation Union (IUCN) lists 46 threatened fish species. This may rise to 296 with the 250+ species threatened by Nile perch (*Lates niloticus*) in Lake Victoria.

Africa's fish genetic resources are important internationally. Cichlid fishes endemic to Africa comprise the foundation stocks of the world's growing tilapia aquaculture production. Many tilapia stocks have introgressed and deteriorated, and need fresh input from Africa which holds the gene bank for the future of tilapia aquaculture.

Twenty-one African countries have imported carp for aquaculture since the 1940s. Carp were introduced for culture in cooler areas and for supplementing tilapia yields. Carp utilize a benthic niche largely unused by native tilapias and grows fast (1-2 kg/year) in the tropics. In aquaculture, total fish production has been reported to increase in carp/tilapia polycultures. However, in carp/tilapia ponds in Malawi and elsewhere, tilapia recruitment often declines due to disruption of nesting.

Escapes of pond-reared carp in Africa have caused adverse effects on native fish faunas. In Zimbabwean reservoirs, *Clarias* sp. has been displaced from its benthic niche causing declines in commercial catfish fisheries. In Madagascar, the carp's habit of digging up lake sediments has destroyed tilapia breeding areas. Carp hasten eutrophication by stirring sediments; 200 kg/ha of carp in a shallow 10-ha lake at 22°C can generate an "internal" phosphorus loading of 2.8 mg total P/m^2/day.

Carp's broad feeding and environmental niches and tendency to harbor contagious diseases make it a direct threat to the conservation of fish biodiversity in Africa. However, in tropical species-rich environments, carp has never dominated fish communities. Disastrous reports of adverse

---

[1]The full paper is published in *Discovery and Innovation*, The African Academy of Sciences, Nairobi, Kenya.
[2]ICLARM Contribution No. 744.
[3]Present Address: Mauna Loa Research Institute, 6 Hale Ohia Road, P.O. Box 1050, Volcano, Hawaii Island 96785, Hawaii, USA.

introductions have been usually confined to regions of low species diversity, to relatively fragile fish communities, or when fish communities are under pressure due to overfishing, pollution, etc. Africa's rivers have highly diverse fish faunas, so carp are unlikely to dominate such areas; however, quiet backwater areas and lakes could be colonized and impacted.

Initially, carp introductions to subSaharan Africa were banned because of danger to endemic species if carp escaped. With rapid development of aquaculture in the 1980s, donor agencies and consultants promoted known species and systems, mainly because of the perceived low cost for development compared with that of developing new systems for little known indigenous species. Hence, common carp was imported to Malaŵi despite the country's having the world's most diverse freshwater fish fauna.

An environmental disaster could occur to Lake Malaŵi if carp escaped. In the open waters of Lake Malaŵi, carp would be vulnerable to predation, but in shallow littoral zones, lakeshore lagoons and marshlands, carp would survive and damage important breeding areas for lake cichlids.

Strong donor and government policies supporting research and extension programs are needed in order to develop native fish species for use in aquaculture and to protect Africa's important fish genetic resources. Only after detailed reviews of longer-term, better-planned research efforts have been done should importation of exotics be considered. Protocols for fish introductions could follow those of the International Council for the Exploration of the Sea (ICES)/European Inland Fisheries Advisory Commission (EIFAC) and the Exotic Species Section of the American Fisheries Society.

Discussion

MALUWA: It is said that common carp has superb culture characteristics and yet production for Malaŵi in 1990 was less than 1 tonne. What are your comments?

COSTA-PIERCE: This may be explained by the fact that farmers in the Southern Region of Lake Malaŵi were hurt by the drought of 18 to 24 months. During this period a number of farmers dropped out and now common carp is kept by very few farmers. That is why production is negligible.

MAPILA: Why should the speaker shoot down carp as "trash fish"? Normally that would apply to carp in European or North American waters where sport fisheries are most important. Their sport fisheries involves more money than food fisheries. Carp is usually found in North American waters which are polluted while in the southern states of America where water is fast flowing, carp are highly regarded among people of oriental origins. On the other hand, in Malaŵi, people eat carp and prefer it. If we make a comparison between European/American and African water systems, the configuration and the nature of water catchments are different and those found in subSaharan Africa are easily amenable to fisheries management.

The history of *ntchila* (*Labeo mesops*) in Malaŵi contradicts our expectations concerning carp. Thousands of tonnes of *ntchila* used to come out of Lake Malaŵi and used to be caught all over rivers and lakes. This fish is now virtually gone and we are not sure as to what happened to this fish species; is it possible that another fish came in and took over its niche? The problem of carp in Lake Malaŵi may not necessarily be its high production because a large number of people are likely to catch it. For instance, recent reports on the waters of Kenya indicate that people have stopped killing Nile perch because it is finished. So when considering carp some of these points need to be considered.

COSTA-PIERCE: Public perception of carp for food is one thing but the environmental impacts in Lake Malaŵi may be different from what is hypothesized. So let us not just respond to public perceptions when drawing scientific conclusions.

MKOKO: You indicated that if we continue growing carp the effect on Lake Malaŵi may

be beyond what has happened with Nile perch in Lake Victoria. Can you explain why you said so? This is a very controversial point when one talks to people coming from East Africa. There are those who say what they require is protein and that the total amount of protein being obtained from Lake Victoria is more than what it was in the past. Of course, another school of thought says there is a need to preserve their natural species. Does Africa have to pay a cost for preserving its natural resources at the expense of nutrition?

COSTA-PIERCE: The main worry about Lake Malaŵi is that, first of all, it is an irreversible experiment once exotic fishes get in. The consequences are unknown, but there is enough known from other areas to arrive at some reasonable judgements. It is not the pelagic, open waters of Lake Malaŵi presently inhabited by adult *chambo* (*Oreochromis* spp.) stocks that may be colonized, but the littoral zones and backwater areas which are shallow and weedy. The major impacts, I feel, would be in these ecosystems which would experience increased suspended solids, eutrophication, destruction of reproductive sites and uprooting of aquatic weeds. If we are convinced that most of the *chambo* species use the Lake Malaŵi littoral zone at some phase of their life cycle, then our main concern should be that of a possible decline in reproductive success of *chambo* stocks.

While it is true that Lake Victoria now produces more fish than it ever did, the big concern is that Nile perch stocks may behave similarly to carp stocks in Aswam Dam, Egypt. When common carp got into the Aswam Dam, carp populations soared but after 20 years they collapsed following a huge deoxygenated zone in the lake. This caused suffering to a great number of fishers. The other big concern about Lake Victoria is that the exotic species may not yet be in equilibrium with the ecosystem's natural resources to support it and eventually the fishery may collapse.

Public perceptions and cultural backgrounds can change when relative fisheries changes are dramatic but both raise major concerns. In Kenya, people were tilapia eaters but when Nile perch took over the ecosystem they were forced to accept the Nile perch quite suddenly as there were shortages of native tilapias in the market. The cultural background of the people was compromised. While we may expect the same to happen to common carp once it gets into Lake Malaŵi, public perceptions could be interrupted and this would affect orderly development.

MSISKA: There is one thing we should not dismiss so easily and that is the question of sustainability. What is happening in Lake Malaŵi, the rate of fish speciation taking place is high and no one knows about it and whatever is evolving. All this means the natural equilibrium may or may not have been reached. Fluctuations of lake levels would suggest an unstable system. Our problem is to sustain what is being produced from Lake Malaŵi and if we look at aquaculture production over the past years, it hardly reached 1,000 t per year. So, for all practical purposes, let's try and maintain the natural fishery situation as it is. This is not to imply that if common carp is thrown into Lake Malaŵi then production will not increase. Or, in the short term maybe the system will not be able to sustain production on a more predictable basis. Whatever the case, it is difficult to quantify the aesthetic value of the resources and be futuristic about fish species we know little about.

RASHIDI: In continuation of the same concern, I fear the tendency to express environmental issues as if it is compromising the pros and cons is too much of a simplification. This is dangerous: if we have to make a decision then we must not take the half-measures as this attitude could lead to disaster. If we take the pros and cons of such an issue based on current knowledge, what will happen with time might, on face value, appear attractive.

COSTA-PIERCE: As an advisor to the government of Malaŵi and as a scientist I do not need to go into government policy because that is up

to Malaŵi. However, a reasoned decision must be taken after considering all sides. On a very simplistic level, if you do not want to work on this fish because you fear the unknown, then it should be eradicated, but if it is something you want to work with as part of your new farming systems, then you will always be faced with how to deal with it, from all aspects.

LIKONGWE: What would happen if we had six billion carp in Lake Malombe? Should we expect the bottom to become muddy and the water to become very turbid such that the light can not reach the bottom? The release of phosphorus can increase food production for certain species, however, production of carp even in still waters has resulted in reduction in yields of other species. We should therefore carefully consider this aspect before making a final decision.

MSISKA: The figures on world carp production do not tell us about the dynamics of growth of the industry. Since you pointed out that 90% of carp production is from China, then there is not much of it in other countries. The dynamics of production of other species once we take away the Chinese production may show interesting changes in the fish species over time. Until now most of the species which have been introduced in aquaculture are still basically wild stocks except possibly for trout and carp. Therefore, success may lie in combining genes from several strains and species. For instance, the success of carp should be judged as well by checking how much genetic improvement work has gone into it. The catfish industry in the USA is booming right now partly because of genetic gains from different strains. So when we compare carp with other species, investment into exploiting gains from domestication should be considered. Common carp benefited from such an approach.

COSTA-PIERCE: Common carp and trout are at the maximum in terms of genetic improvements, other species except for maybe American catfish are still essentially wild stocks. Except for Asia, carp culture appears to be declining throughout the world. There are other fishes that are less bony and have more firm flesh whose fingerlings are readily available from natural rivers. In the past in China, common carp were raised with complementary species (two or three species) but now there are a number of different species such as tilapias which have begun to compete for the same space in fishponds there.

MKOKO: The production of carp in Malaŵi is indeed small, 1 tonne annually. Do we have any reference or any citings apart from Fisheries Department records of escapes to the natural waters in the Lower Shire catchment area?

RASHIDI: Mr. N. Cummings of the Sugar Company of Malaŵi (SUCOMA) was reported to have heard of someone who got a strange-looking fish caught from the Shire River. Nobody has seen the sample to confirm if indeed it was a carp. It is likely that such a fish may have escaped into Shire River from the Kasinthula Fish Farm or the farm at SUCOMA.

MAPILA: We should also consider what would be the impact of carp if it got into Lake Chilwa where the most important species is a small pelagic species, *matemba* (*Barbus* spp.), which is preferred in Malaŵi. Would eutrophication of Lake Chilwa not promote *matemba*?

DICKSON: I was intrigued by your conclusion on possible environmental impacts of carp in Lake Malaŵi because carp does well in tropical climates where there are few species. Lake Malaŵi is stable with a complex assemblage of species including predators. I would speculate that carp will not do well in Lake Malaŵi.

GLOERFELT-TARP: You earlier mentioned the damage carp could cause in Lake Malaŵi with particular emphasis to the littoral zone near Mangochi. I am convinced that carp will cause more damage to the designated fishing zones of southeastern Lake Malaŵi than commercial trawling has done.

COSTA-PIERCE: Dr. Malcolm Dickson's

comments about Lake Malawi being stable are not true, it is fluctuating dramatically and therefore is a very unstable environment. Concerning fish predators, I think it is unlikely that the open waters of Lake Malawi will ever have major carp populations but this may be different in the littoral zone and the backwaters where nesting activities of tilapia are concentrated. Predator-prey relationships are oftentimes complicated by shelters for prey populations which protect forage fish from predators by weeds, obstruction, etc.

A combination of heavy trawling and an exotic species could be a biological catastrophe. In North America, native fish populations collapsed more readily as a second or third impact has them. Cumulative effects of overfishing, pollution and exotic species appear more powerfully detrimental than just additive effects.

The effects of trawling should not be an agent for justifying the introduction of an exotic species. Since the Lower Shire River is connected to the Zambezi River, the Zambezi and the Shire could exchange carp and *Oreochromis niloticus* which have escaped into the Zambezi from aquaculture operations in Zimbabwe.

NOBLE: In Lake Malawi, it is the littoral zone habitats that are most unstable because the water levels change by several meters.

Formulation and Status of Government Policy on Common Carp

B.J. Mkoko, *Malawi Department of Fisheries, P.O. Box 593, Lilongwe, Malawi*

J.T. Mutambo, *National Aquaculture Centre, Malawi Department of Fisheries P.O. Box 44, Domasi, Malawi*

Abstract

In 1972, a pilot commercial fish farm was built at Kasinthula in the Lower Shire Valley, Malawi. Growth trials were initiated with indigenous species, *Oreochromis shiranus chilwae, Tilapia rendalli* and *Serranochromis robustus*. Yields of these species were so poor that in April 1975 a UNDP/FAO project entitled "Promotion of Integrated Fisheries Development" was presented to the Secretary for Agriculture and Natural Resources. The project's objective was to design commercial systems utilizing exotic fish species such as common carp, Chinese carp and *O. mossambicus* in polyculture with indigenous species. Some concern was expressed by the Ministry over introduction of exotic species but permission was granted contingent on assurances that Malawian fish species were not at risk. Concern over exotic fish species was reflected in the Malawi Fisheries Act (CAP 66.05) which discourages fish importations.

The Fisheries Department (FD) applied to the Secretary for Trade and Industry to import from Israel 100 common carp (*Cyprinus carpio*), 100 grass carp (*Ctenopharyngodon idella*), 100 silver carp (*Hypophthalmichthys molitrix*), and from South Africa, 100 *O. mossambicus*. On 24 April 1976, permission was granted, "provided the importer will ensure that the named fish will not enter the natural waters/lakes of Malawi."

By June 1976, at Kasinthula, fish growth rates averaging in excess of 8 g/day for silver carp and 4 g/day for common carp (mirror carp) during a 150-day culture period were obtained. The Ministry agreed that research should continue and more fish be imported. Exotic tilapia (*O. mossambicus*) performed poorly and further trials were abandoned. Other tilapia species such as *O. niloticus* were requested for experimentation at Kasinthula but no efforts were made to bring them into the country.

The need to introduce exotic fish species arose from strong pressure to make Kasinthula Fish Farm financially viable. Although an active national and international debate occurred over exotic fish species in Malaŵi, little thought was given by the consultant to the possible impact of carp to Malaŵi's natural ecosystems if the fish were distributed to farmers. In addition, in FD files there is no evidence of a willingness to distribute carp to farmers after the June 1976 UNDP/FAO report on carp was presented to the Ministry of Agriculture and Natural Resources.

In 1984, the FD formulated conditions for distribution of common carp to farmers: only farmers outside the Lake Malaŵi catchment area would be allowed to raise common carp; no farmer would be allowed to breed the fish; and all carp fingerlings were to be supplied from government fisheries stations (Domasi and Kasinthula) at a nominal price.

The decision to import carp was influenced by the perceived absence of a fast-growing local species and a strong need to provide protein and farm employment where incomes and food production were low.

Discussion

NOBLE: The reasons why common carp might have to be eradicated are scientific. We have to protect indigenous species because of attributes which they have and which may or may not be of value to aquaculture in the future. Good aquaculture species may exist in Malaŵi, but for various reasons, we may not know about them. By protecting all fish species we may be preserving those of potential commercial value to smallholder farmers in future generations.

MKOKO: With reference to the scientific reasoning pertaining to protection, we should deal with issues much more broadly so that we consider what may have been neglected in the past. We may have to deal with a long list of what is considered scientifically sound. For instance, some of the reasoning behind conservation may not apply to aquaculture.

NOBLE: There may be a worry that if we decide on the eradication of common carp, we may not be sure how to replace it. In fact, we may in the process be protecting fish for reasons which are irrelevant for the future of the aquaculture industry.

RASHIDI: For some very good reasons, it was directed to introduce common carp in the Southern Region outside the catchment area of Lake Malaŵi. While it may now be difficult to tell people to do away with carp, it is breeding in farmers ponds which was originally not forecasted. It was thought that carp could not breed in farmers ponds in Malaŵi. Thus, if the fish were to enter the catchment areas of Lake Malaŵi, we will have lost control.

DICKSON: I understand common carp was introduced for experimental purposes at the Kasinthula Fish Farm, but then how was the decision to introduce it to farmers made: was that by the Chief Fisheries Officer or the Ministry?

MKOKO: The government had to respond to farmers' requests. The recommendation at that time was to release it to few farmers as Mr. Rashidi will testify, to maintain control over carp stocks. And the premises which the government used to justify that may now not be entirely valid.

MSISKA: The decision which was made must have been wrong in that it was felt that carp

would not breed in shallow waters. In temperate areas, it takes a long time for common carp to start breeding, but in Malawi the spawning period is substantially reduced to 6-9 months showing that it could proliferate faster in Malawi. Since the decision was made using wrong assumptions, the problem has to be faced squarely by reversing the introduction in light of up-to-date knowledge.

MKOKO: At the time, information on carp breeding in ponds was not available and the state of information was poor; however, if we go witch-hunting we will not have solved the problem.

MSISKA: Given the most up-to-date facts about carp, the whole problem becomes one of managing change. When discussing carp introductions into Malawi in the 1970s, the only other country in subSaharan Africa which had common carp was Cameroon. Outside of that experience, previous experiments in Uganda at Kajansi Fish Farm showed common carp never established itself.

COSTA-PIERCE: My questions relate to what has been stated in your paper on fish species. I am very surprised to hear reports of importations of other cyprinids; other than common carp I had no idea that *Oreochromis mossambicus* was also imported from South Africa. So, common carp was not the only fish that was recommended for Malawi to import. Perhaps this should have been included in the background of your discussion paper. Could you please explain the background to a whole suite of fish introductions?

MKOKO: Apart from carps, recommendations were made but not carried out except for *O. mossambicus* which was imported from South Africa because related strains were already in Malawi. However, the aim was to find species of fish which were more robust.

MSISKA: The background to the *O. mossambicus*' introduction from South Africa was that different techniques of raising local *O. mossambicus* at Kasinthula had been explored, including manual sexing, but it was not possible to obtain individual fish beyond 150 g in less than one year. When a Fisheries Consultant, Mr. P.B.N. Jackson from South Africa learned this, he recommended that we consider better-growing strains of *O. mossambicus* from South Africa. The reason for this was to compare with local fish. However, results were disappointing and this introduction may be considered to have been a failure.

COSTA-PIERCE: Regarding the aquaculture work that began at Kasinthula, where did the original stocks of *O. shiranus* and *T. rendalli* originate?

MSISKA: Original stocks of *O. shiranus chilwae* were moved from Domasi to the Kasinthula Farm in 1971 from which the first harvest was obtained in 1972. *Serranochromis robustus* was introduced from Lake Malawi to Domasi as a predator to control over-breeding of tilapia, but never made it to Kasinthula. It was reported that farmers were concerned about *O. shiranus* being too small; therefore *Clarias gariepinus* was added to raise fish to a larger size by controlling over-breeding by *O. shiranus*. *Clarias gariepinus* was introduced to Domasi from Lake Chilwa; stocks at Kasinthula came from the Shire River.

COSTA-PIERCE: It seems much of the focus has been to protect Lake Malawi and that all regulations are geared to that objective. I note that all farms given common carp are outside of the Lake Malawi catchment area (i.e., in Zomba) and as such would escape into other drainage basins and possibly establish in, say, Lake Chiuta. Similarly, fish could escape to the Lower Shire River. Is it government policy to protect the other waters of Malawi like Chilwa, Lake Chiuta, the Shire River and rivers in Zomba area?

MKOKO: Naturally, all water systems were thought of in government policy and were

referred to in the common carp restrictions. It was thought that carp would not breed outside its native range and the trial was to gauge its performance in Malaŵi, and the areas outside the Lake Malaŵi catchment were chosen deliberately. But as it stands the policy is to protect all natural waters of Malaŵi.

COSTA-PIERCE: It is very interesting that out of the three carps that were imported, the carp that breeds most readily under natural conditions was distributed widely and the two that do not breed without hormonal manipulations were destroyed.

MSISKA: At the 1975 FAO Symposium in Accra, Ghana, this issue was raised because it did not affect just Malaŵi. In fact, Cameroon wondered why they had common carp which could not breed freely in ponds. It was thought that none of the carps would freely proliferate in ponds because of predation from *Xenopus* spp. frogs. All the FAO experts were there, including the Israelis to testify to this observation. Of course, on more than one occasion they have been proven wrong.

NOBLE: What criteria did you use for distribution of common carp to farmers?

RASHIDI: Initially we decided to select farmers who had demonstrated good management skills and rapport with the Fisheries Department so that should there be a need to destroy the fish there would be no resistance. However, a spontaneous response was noticed among other farmers who had experienced poor production with the native tilapias so that at the end we just distributed common carp to any farmer who wanted them in Zomba and Mulanje.

NOBLE: How many farmers actually received common carp?

RASHIDI: Most fish farmers from Mulanje and Zomba received common carp.

MSISKA: When names of farmers to receive common carp were processed by the Ministry, the original number was 20. For every farmer wanting to get carp, the Ministry had to approve. The Fisheries Department was supposed to convene a meeting of experts after two years to review the outcome and discuss a future course of action. This was never done, apparently, and it appears that lately, things have gotten out of control.

History of Common Carp Introduction to Malaŵi

O.V. Msiska, *Department of Research and Environmental Affairs*
P.O. Box 30745, Lilongwe, Malaŵi

Abstract

Exotic fish introductions into African waters are controversial because they may lead to adverse environmental changes, such as in Lake Victoria, due to introduction of Nile perch (*Lates niloticus*) and Nile tilapia (*Oreochromis niloticus*). Existing capture fisheries could be endangered and local species which may have potential for aquaculture driven to extinction. The biodiversity of African

fish fauna would be at risk, particularly in fish communities such as those endemic to the Great African Lakes where species diversity is high but individual species abundance is low.

Leading international scientists who advocated carp for Malawi supported exotic fish introductions to Lake Victoria and other East African waters. These scientists had access to donor funding and hence went mostly unchallenged by their African counterparts. In the 1960s, experiments in Israel demonstrated that in intensive aquaculture, carp grew faster than other cultured fish species commonly used at the time. In 1969, a joint Malawi Fisheries Department (FD)/FAO survey of fish yields of Malawian species was carried out.

Results indicated low fish yields from ponds and dams of 0.1-0.2 t/ha/year for Northern Malawi and 0.5-1 t/ha/year for Southern Malawi. UNDP/FAO funds were offered for a fish farm to test local species (*O. shiranus, Tilapia rendalli, Serranochromis robustus*) for aquaculture. Yields were poor, not exceeding 1-2 t/ha/year. Test trials of carps were suggested and in June 1976, the Malawi government agreed to 1,300 fingerlings being imported from Israel. The genetic origin of the carp was mixed. Progeny later produced in Malawi exhibited scale, orange scale, leather and mirror phenotypes indicating that parent fish originated from China as well as Europe. Carps performed well in experiments with growth increments averaging 8 g/day for silver carp, and 4 g/day for common carp for 150-day culture periods. Growth rates for the best-growing indigenous species never exceeded 1 g/day, even for the exotic *O. mossambicus* introduced with carp.

The rush to introduce carps overlooked the fact that poor yields of Malawian fish that were reported in consultant's documents were not comprehensive enough. For instance, yields of 2.3 t/ha/year for *T. rendalli* which were obtained from ponds at Lujeri Tea Estates did not get the publicity they deserved considering that low quality inputs were used. Only three local species were tested during the short-term (2 years) UNDP/FAO project neglecting many others which may have performed better. *O. karongae* (*saka*) and *O. lidole* from Lake Malawi demonstrate natural growth rates equal to and often better than two of the most widely cultured tilapia species, *O. niloticus* and *O. aureus*. *Bathyclarias* sp. from Lake Malawi have recently exhibited growth rates in ponds of up to 16 g/day. The 1969 surveys of Malawian fish species from ponds and dams were much too superficial to provide accurate estimates of performance. Consequently, "proven" technologies and species for adoption to local circumstances were imported. Limited funds for research on the aquaculture potential of indigenous fish, and foreign scientists attachment to the systems and species they knew led to the importation of exotic fish species.

Unnecessary introduction of exotic species needs to be avoided so that biodiversity of valuable fish stocks of the Great African Lakes can be conserved and exploited rationally. Indigenous fish species (e.g., *Oreochromis* and the *Nyasalapia* group, *Bathyclarias, Barbus*, etc.) may have great potential for African, or even worldwide aquaculture and need more investigation before they are endangered by exotic introductions. Certainly for aquaculture to succeed in Africa, fish polyculture using indigenous species is likely to provide the most effective approach because the fish are uniquely adapted to the African environment.

Discussion

NOBLE: The foreign fisheries experts came from a strictly intensive commercial aquaculture background. They did not have any knowledge of aquaculture at the rural, smallholder level. I know some of the people involved who came here who failed to appreciate the problems faced by smallholder farmers involved in rural aquaculture development.

COSTA-PIERCE: Were the objectives of the project which introduced common carp commercial, or for the use of aquaculture as a mean of rural development? Is my impression right that aquaculture started off from looking at its

commercial feasibility rather than the smallholder development side?

MKOKO: That is a complex question because there are several approaches to alleviation of rural poverty. We could either proceed with the development of commercial aquaculture or through smallholder aquaculture to raise the incomes of rural people. It is also a complex question if you do not have full knowledge of the target group. The other point, of course, is whether planners want to improve the rural areas through fish farming.

MSISKA: In the fish farming consultant's report, the conclusion reached was that fish farming could not develop in Malawi except in the Lower Shire River basin and at lower elevations in the Central and Southern regions. Some yields were obtained from smallholder fishponds which were not impressive to the consultants (i.e., 500-1,000 kg/ha/year). If you look at smallholder fish production now, yields have not changed greatly. It is the way some developers view successful aquaculture development in terms of thousands of tonnes irrespective of fish distribution. I would guess that the consultant might have been driven by the concept of commercial fish farming, having come from Israel where big ponds (>1 ha) were the norm.

NOBLE: So they had no concept of the potential of integrated aquaculture among smallholder fish farmers?

MKOKO: During that period the government emphasized high production per unit pond area.

RASHIDI: From the searches I have made, introductions were carried out in British protectorates like Malawi, Uganda and Tanzania. Were these recommendations made from London? If so, how were these communicated to the countries because fish introductions made in Malawi were also advocated for Tanzania? For example, *O. niloticus* was introduced in some water bodies and catchment areas close to Lake Malawi under ODA-sponsored projects. What was happening here? How much communication went on? Nowadays, what role is SADCC (through a project like the SADCC/ODA Pelagic Fisheries Project) playing in initiating international cooperation in fish introductions? Are there any existing mechanisms that address these issues?

MKOKO: The SADCC/ODA Pelagic Fisheries Project in Salima has a role in bringing the riparian countries together on the management of fish stocks and protection of endemic fishes of Lake Malawi. In that regard the project will definitely assist in the international management of Lake Malawi.

MSISKA: One of the few visible international attempts that have been made to create an awareness of conservation of fish genetic resources for aquaculture in African waters is by ICLARM through a post-ISTA II genetics workshop in Bangkok in 1987 (Pullin 1988[1]). Obviously, even if a country on one side of Lake Malawi tries to conserve genetic diversity, the activities on the other side could nullify any good intentions. That is why the effort made by ICLARM in 1987 to bring people from Africa and Asia together to discuss tilapia genetic resources was opportune as it created a common understanding and purpose. I guess after that it is up to individual nations to take up the challenge and think deeply about their fish genetic resources anywhere within their country other than paying lip service to conservation at international meetings. Even agriculturists, who have a long history of conservation, have had problems protecting local lines from contamination and genetic erosion. Therefore the merits of *ex situ* and *in situ* gene banks should be examined in relation to fish resources. Conservation efforts have not been very well coordinated in the past but this is where an international effort through regional bodies such as SADCC or CIFA is urgently required before some of the genotypes are lost and natural variability is

[1]Pullin , R.S.V. 1988. Tilapia genetic resources for aquaculture. ICLARM Conf. Proc. 16, 108 p.

reduced. I do not think adequate efforts are being made in fisheries science in Africa to conserve genetic diversity despite the existence of several organizations within the region.

MAPILA: We are worried about the introduction of common carp today in Malawi. There was a strong indication by South Africa that carp which has been released from a dam in Swaziland and washed down to some rivers of South Africa was causing a lot of havoc to that country's natural systems. So we should act collaboratively with our friends in the region so that we act with a consensus before a disaster befalls us. For instance, indigenous fish are already under threat from such fish as black bass (*Micropterus salmoides*) which have become established in Southern Africa. Introduction of black bass was made a long time ago to Malawi in water reservoirs such as Malingunde and Ngapani which are connected to Lake Malawi. In Salima, lungfish (*Protopterus annectens*) were introduced and have now made their appearance around Nkhotakota. This is bound to affect some endemic species. Thus, apart from carp we should consider a whole range of exotic fishes which are probably affecting the biological diversity of fishes native to Malawi.

KAUNDA: Conservation efforts are likely to be affected by lack of or inadequate information on the fishes of Lake Malawi as we have found through the ICLARM/FAO FishBase Project. Relevant information on capture fisheries to assist in management is in most cases scanty especially with regard to food fishes. Although there are many species (ca 550), little is known about them and least of all how they affect the aquaculture industry. Aquaculture would like to benefit from lake species but one has to start collecting basic biological studies in the lake in order to identify potential fish species.

MKOKO: In the past, the status of fisheries research in Malawi was such that many internationally recruited researchers more or less engaged at will in research of their own taste. Now the approach has changed so that one has to fit into our priorities. This will deter fisheries scientists to come and engage in such hobbies as collecting butterflies which has little relevance to fish.

Status and Performance of Common Carp on Estates in Malawi

O.V. Msiska, *Department of Research and Environmental Affairs*
P.O. Box 30745, Lilongwe, Malawi

Abstract

Estate fish farming has developed for three main reasons: (i) to provide a source of fresh animal protein to the workforce; (ii) to provide a midday meal of fresh fish and attract seasonal labor during peak harvests; and (iii) to experiment with economic diversification of farm enterprise. Some estates such as the Sugar Corporation of Malawi (SUCOMA) have a mandate to provide fish from their ponds to workers at strictly controlled prices. Other estates provide only a portion of their fish to workers, usually smaller fish, with larger fish going to market for sale. Production of fish for sport has had priority over production of fish for food in some estates.

When foreign fisheries consultants arrived in the late 1960s, fish yields from ponds and reservoirs were reported to be 100-200 kg/ha/year in the Northern Region and 500-1,000 kg/ha/year in the Central and Southern Regions, with most ponds "poorly managed" and indigenous species "poor performers". However, at Lujeri Tea Estates in Mulanje, fish yields of 2.3 t/ha/year for local species were achieved using inputs of 1 t/ha lime, 20 kg/ha/day cooked ground maize and 80 kg/ha/day of fresh grass.

Prior to distribution of common carp, the Fisheries Department (FD) in 1984 made the following conditions concerning carp distribution which were universally applied to all the farmers: (i) carp to be restricted to farms outside the Lake Malaŵi watershed; (ii) final approval for a select group of farmers to receive carp lay with the Ministry; (iii) farmers would not be allowed to breed carp but must get fingerlings from government stations; (iv) farm ponds must have screens on inlets and outlets in ponds to prevent carp escapes; (v) at harvest all fish must be killed and sold in the presence of a Fisheries Officer; (vi) all farmers growing carp must submit records on their carp stocks and provide information on carp transfers to neighbors.

When common carp became available in the late 1980s, distribution was restricted to two estates, SUCOMA and Satemwa Tea Estate (STE). These estates were outside the Lake Malaŵi watershed so there was no chance that carp could escape into the lake.

Records from 1976 show that STE initially used irrigation dams for aquaculture, then six drainable ponds were built for better control of fish production. Pond area totaled 1.8 ha with sizes ranging from 0.16 to 0.4 ha. Initially, stocking was of manually sexed *Oreochromis shiranus chilwae* and unsexed *Tilapia rendalli*. Stocking rate was 1.3 fish/m^2 (1:4 species ratio, respectively) and yields averaged 1.6 t/ha/year from 1981 to 1986. Introduction of common carp with these species caused a production decline of 50% initially from 1.6 to 0.8 t/ha/year. Carp fingerlings were stocked at 1.6 fish/m^2 and tilapias at 1.2 fish/m^2. In later years, average yields of carp/tilapia polyculture rose but were still consistently lower (1.3 t/ha/year) than those of the two local tilapias (1.6 t/ha/year). Carp contributed to approximately 37% of production in polyculture.

SUCOMA achieved a record yield of 5.3 t/ha/year with indigenous species in 1983. Since the introduction of carp production in 1986, production has ranged from 2 to 2.6 t/ha/year. Although production figures are lower, estates still favor carp because of their large, uniform size at harvest. To produce large tilapias and carp, estates have implemented long culture periods (190-430 days) and tried stocking all male *Oreochromis* sp. SUCOMA manages two production cycles per year and STE one. Estates raise their own tilapia fingerlings but carp are supplied by the Fisheries Department. Carp supply is low, and is said to be too few in number to raise stocking densities to any appreciable production levels.

As carp may be withdrawn, estates are stocking with *Clarias gariepinus*. The FD is also experimenting with *Oreochromis karongae* (*saka*) and *Bathyclarias lowae* from Lake Malaŵi. Both species have strong local market appeal and *C. gariepinus* is already supporting a multimillion Rand industry in South Africa and should prove an effective alternative to carp.

Discussion

RASHIDI: SUCOMA has already gone a long way in looking at alternative species. They are engaged in the captive breeding of catfish; maybe other farmers should be introduced to this technology which I think would be a positive direction for fish farming.

MAPILA: The Lower Shire River area is where the catfish probably attains a good growth rate. What about most of the fish farmers who are doing fish farming in other areas?

MSISKA: One of the observations that may be relevant to that question is that *Clarias*

gariepinus occurs throughout Malawi. Furthermore, it is grown successfully in Lesotho which is generally colder than Malawi. This suggests that there may be strains which are adaptable to cooler environments.

MAPILA: We discussed catfish at the SARCCUS meeting but unfortunately we did not enquire into the relevant details about this fish. Acquiring catfish from outside Malawi would raise the issue of unlawful introductions.

Status and Performance of Common Carp on Smallholder Farms in Zomba District, Malawi[1,2]

R. NOBLE, *ICLARM/GTZ Africa Aquaculture Project*
P.O. Box 229, Zomba, Malawi

Abstract

Carp (*Cyprinus carpio*) was introduced to the Domasi Experimental Fish Farm, Zomba, Malawi, in 1977. In 1984, the Fisheries Department (FD) decided that experienced farmers outside the Lake Malawi watershed could receive carp. However, before this directive, 120 carp were distributed to two farmers at Chingale within the Lake Malawi watershed in November 1979. This appears to have been the only case of such distribution of carp.

In 1985, 375 carp were distributed among three farmers at Chipola, Zomba. Carp fingerlings were stocked with *Oreochromis shiranus* and *Tilapia rendalli*. After eight months, fish production was 0.3, 0.7 and 1 t/ha/year from the three ponds. On average, carp accounted for 10% of the fish in numbers and 42% of the catch by weight. *O. shiranus* comprised 80% of catches by number and 49% of catches by weight and *T. rendalli*, 10% by number and 9% by weight. Average weights for carp were 400 g, *O. shiranus*, 57 g and *T. rendalli*, 78 g. In 1988, over 6,000 carp fingerlings were distributed to 34 farmers in 1989. Twenty-five farmers harvested carp in 1990 and in 1991 carp was withdrawn pending discussion of its future in Malawi.

In 1989-1990, pond harvests of polycultures of *C. carpio*, *O. shiranus* and *T. rendalli* were monitored by ICLARM and FD. Average yields were 1 t/ha/year (range: 0.1-2.6) in 1989 (mean culture period: 358 days, standard deviation: 49) and 0.5 t/ha/year (range: 0.06-1.6) in 1990 (mean culture period: 324 days, SD: 125). At harvest, carp contributed 6-7% by number, 37-45% by weight and 40-60% of potential harvest value. Mean carp weights were 14-16 times those of *O. shiranus* or *T. rendalli*; but their faster growth reflected low carp stocking densities (mean: 0.2 fish/m^2 in 1989). Carp yields (293 kg/ha/year, 1989; 230 kg/ha/year, 1990) were lower than those of *O. shiranus* (566 kg/ha/year), 1989; 250 kg/ha/year, 1990). *O. shiranus* fingerlings contributed by weight: 26% in 1989 and 46% in 1990.

---

[1]ICLARM Contribution No. 935

[2]Special thanks must be given to Mr. Sloans Chimatiro and Mr. Khupe of the Malawi Department of Fisheries for their assistance in carrying out the field research; to the staff of the National Aquaculture Centre for allowing me to examine their harvest data from farmers' ponds; and to ICLARM field staff who assisted at farm harvests.

This research program was funded by the Deustche Gesellschaft für Technische Zusammenarbeit (GTZ), GmbH, Eschborn, Federal Republic of Germany.

ICLARM/FD surveys demonstrated that carp do not significantly raise production above that of local fish species (0.7-2.45 t/ha/year for *O. shiranus/T. rendalli* polyculture). In 1989, carp prices were K3.00/kg (US$1.00/kg), and contributed 50% to the sales value of harvests. Carp prices varied from K1.50-K2.00/fish weighing 350-400 g compared with 20 t (US$ 0.08) for *O. shiranus* of 25-30 g and so carp were relatively expensive to buy for rural people.

During this ICLARM/FD survey, carp escaped to waters outside pond enclosures on three occasions during harvests.

Farmers brought fingerlings at a subsidized price of 5 t/fish (US$ 0.02) from 1988-1990, each farmer receiving, on average, 157 fingerlings, costing K7.89 (US$2.80). FD deliveries of fingerlings and monitoring of harvest cost approximately K32/visit (US$11.40) for transport, personnel and nets. None of these costs were passed on to farmers, hence farmers had a false impression of the economic viability of carp culture. Mean values of harvests were K109 (US$39) in 1989 and K60 (US$21) in 1990. If the cost of the FD services had been passed on to farmers, harvest values would have declined to K69 (US$25) in 1989 and K20 (US$7) in 1990, thereby making carp culture uneconomic.

For carp yields to achieve the levels of *O. shiranus*, higher carp densities and expensive inputs such as animal manures, feeds and fertilizers would be needed. Such inputs are currently beyond the reach of most resource-poor Malaŵian farmers who have average family incomes of $130/year or less. Therefore, carp culture is only suitable for relatively rich farmers who may not need any development assistance.

Discussion

MKOKO: How many farmers are growing carp after the drought? Were the escapes of carp from farmers with few resources?

NOBLE: Three farmers. Carp is given to farmers who follow certain pond management practices in order to avoid escapes. However, one of the farmers broke the pond bank to drain the water and the carp was accidentally washed away into the Likangala River. All effort was tried to catch the fish but without success. So we should be aware that even good farmers who manage their ponds well can experience escapes.

MAPILA: Can you please elaborate on the dropout rate of farmers following withdrawal of carp?

NOBLE: We have not checked on that.

MAPILA: Could you please elaborate on the performance of carp in Zomba area in comparison with the other areas? Will carp growth be the same in Zomba and the warmer Lower Shire?

NOBLE: In the Lower Shire production is 5 t/ha/year. Carp is also doing well in Zomba and all fish species from Domasi are inferior to carp. In Chinseu, however, the soils are more alkaline and water is better suited for fish raising. The farmers in Chinseu regularly get 2 to 3 t/ha/year from indigenous species.

MKOKO: In your opinion what will be the likely effect on farmer incomes if we phase out carp?

NOBLE: The number of farmers rearing carp is about 20 in Malaŵi. The problem is that carp was withheld from the farmers without any explanation. Although the group is small it is composed of influential members of the community and since nothing has been provided in place of carp, this could lead to most of them abandoning fish farming.

COSTA-PIERCE: Are there any farmers that have reproduced carp on their small holdings?

NOBLE: Carp spawned at one farm near Songani in a pond which had grass growing at

the edges. The carp bred on the grass, and in the absence of predators, survival was high. Carp and *Oreochromis shiranus* were raised together and there has been a significant rise of production on the farm.

COSTA-PIERCE: How much is the dropout rate and what is your assessment about the effect of the drought?

NOBLE: There used to be 20 carp farmers and now there are two to three farmers mostly due to drought. I don't know what is the impact of drought versus that of carp withdrawal.

CHIMATIRO: There has been quite a number of dropouts because of drought which was compounded by the absence of carp fingerlings. There has been an impact on their thinking such that some of them are now very reluctant to prepare ponds for the next crop. Fish farmers who are discouraged now grow sugarcane. Most of the ponds were constructed on *dimbas* (wetlands), as such, it is easy to convert them to other crops such as sugarcane. Fish farming is said to be more profitable because of carp.

CHIKAFUMBWA: While we consider carp withdrawal we should offer other options to farmers. It has been reported that fish-rice farming is more profitable than fish alone, maybe this package would alleviate the shortfall in profits experienced after carp withdrawal.

CHIMATIRO: It was a mentality built into farmers that only those who could demonstrate high managerial abilities would be supplied with carp. The farmers worked hard in the hope that they will be supplied with carp.

MAPILA: It is a fact that what is going on is not healthy because it might take 10 to 15 years for the Fisheries Department to rebuild confidence among fish farmers. It has been discussed time and again that when you give a fish farmer the right fish such as carp and next you withdraw it, you disappoint him. Are we not changing the technology a little bit too fast for the farmers? It is easy for farmers to stop fish farming because they may make more money from sugarcane or rice/fish farming. Is it not true that fish and rice farming are not highly compatible? Since farmers are already adopting it they should be more widely encouraged.

COSTA-PIERCE: Farmers have remarkable flexibility and adaptability and once they get knowledge about integrated farming they can produce high returns. They will also consider aquaculture as a part of an integrated farming system. Aquaculture produces synergy with other farming systems and we have learned that once these farmers get the knowledge they implement it quickly if the labor and other resources are available.

You mentioned something dramatic about carp escaping into the Lake Chilwa basin. This is the second time we have heard about carp escapes. Mr. Rashidi said it is possible that there are escapes into the Lower Shire. These reports could assist in the evaluation of environmental impacts by common carp.

Secondly, is the price the same for carp and other fish?

NOBLE: When pricing fish, the farmers do it by size. They set the price in relation to the size of fish.

COSTA-PIERCE: Any idea of what form of carp Malaŵians prefer?

NOBLE: I was told by a lot of people that they bake carp.

MSISKA: Mostly it is smoked carp that is preferred. The majority of Malaŵians do not like carp cooked fresh because of the high fat content.

AMBALI: I have heard some farmers are discouraged and are dropping out. If the Fisheries Department was to make a strategy for the next 5-10 years we should know that there are less than 10% of farmers in Zomba who have so far grown carp. Should we recommend to distribute carp only to these farmers or to all farmers?

NOBLE: The damage is already done. Probably the best approach is to try and encourage the farmers to build up their confidence in Fisheries Department again by telling them that these actions are not meant to destroy their livelihoods. We should tell them that there is a problem with carp and should give them other opportunities to increase fish production through integrated systems so that they do not experience a shortfall in their incomes.

Selection Criteria for Indigenous Fish Species for Aquaculture in Malawi[1]

D.M. JAMU, *ICLARM/GTZ Africa Aquaculture Project*
P.O. Box 229, Zomba, Malawi

O.V. MSISKA, *Department of Research and Environmental Affairs*
P.O. Box 30745, Lilongwe, Malawi

B.A. COSTA-PIERCE, *ICLARM/GTZ Aquaculture Project*
P.O. Box 229, Zomba, Malawi[2]

Abstract

The future development of fish farming in Malawi depends on screening new indigenous species rather than importation of exotics such as common carp (*Cyprinus carpio*). The latter poses a threat to endemic species which have not yet been assessed for their economic potential. Withdrawal of common carp from polyculture systems in Malawi will have an impact on the efficient utilization of pond biological resources although its contribution to national production will largely be unaffected.

Present indigenous species (*Oreochromis shiranus, Tilapia rendalli*) used in aquaculture in Malawi have slow specific growth rates (SGR = 0.11-0.93%/day) and yields result from uncontrolled reproduction (63-67% of harvests are fingerlings). Studies show that *O. shiranus* can grow fast from fry to fingerlings (ϕ' = 3.08), but such performance is short-lived and declines sharply with increasing size.

Early maturity has been one of the major constraints in the production of *O. shiranus*. Studies to determine the relative contributions of environmental and genetic factors to fish growth rate are urgently required.

Development of alternative fish species to boost production and fully utilize available food niches in ponds through rapid screening of indigenous fish is needed. Selection criteria for candidate species should consider biological and economic criteria including price trends, consumption, land constraints, growth of the livestock and feed industries and prospects of local and regional markets. Biological citeria should include data from primary and secondary information sources to determine the environmental tolerances and diet preferences of Malawian fish species. Species characteristics

[1]ICLARM Contribution No. 928
[2]Current address: Mauna Loa Research Institute, 6 Hale Ohia Road, P.O. Box 1050, Volcano, Hawaii Island 96785, Hawaii, U.S.A.

should match the vacant niches apparent in ponds when inputs to ponds are cheap like readily available agricultural waste products and vegetation. Studies in captivity on growth performance, parasites, diseases, reproductive biology and other traits are required to confirm observations made from wild stocks, which, in most cases, provide the only available source of information on species.

Using a procedure for screening growth potential (ϕ')[1] that was developed by the ICLARM Capture Fisheries Management Program and collaborators, several indigenous fish species – *Bathyclarias* spp., *Oreochromis karongae* (*saka*), *Heterobranchus longifilis, Trematochronus* spp., *Labeo* spp., *Barbus* spp. and *Lethrinops* spp. – may fit the criteria developed and require further testing for aquaculture in Malawi. Preliminary indications that *O. karongae* (*saka*) growth performance (ϕ' = 2.84-3.24) is comparable to *O. niloticus* suggests that this may be a strong candidate for aquaculture. *Bathyclarias loweae* has been tested in pond culture and has exhibited high growth rates of up to 16 g/day (SGR = 7.4%/day) and feeds on zooplankton, a relatively unutilized niche in most fishponds. Although these studies are preliminary, it is clear that several indigenous species have potential for aquaculture and that further testing and screening are required.

Discussion

MALUWA: I just read that *Oreochromis shiranus chilwae* attains a growth rate of over 70% in a short culture period, and is very good compared to common carp.

Do the researchers involved in this trial consider on-farm trials with farmers?

How acceptable is catfish in the Zomba area, are there some reservations on catfish?

MSISKA: If you examine literature of these fish you will note that there have been no projects designed specifically for them. I had a project which was funded by the International Foundation for Science (IFS), to investigate *mpasa* (*Opsaridium microlepis*) and *ntchila* (*Labeo mesops*) with respect to spawning. But in the process of conducting this work we came across *Barbus johnstonii*. Similarly, *Bathyclarias loweae* and *B. nyasensis* were collected together with *Oreochromis karongae* (*saka*) because we found them in close proximity. So really there has been no effort to study these fish; that point has already been made. Even capture fisheries is devoid of reliable data and literature is scanty except for taxonomical anecdotes. This is despite the many Fisheries Department projects that have been executed in Malawi. At least for *O. karongae* (*saka*) we now have several research efforts but for other fish we do not have similar research efforts because of lack of finances. Possibly the focus of investigations should be on one or two species by considering its best attributes since it may not be possible to work on all of them at the same time. There is a need to prioritize research efforts.

NOBLE: My impression is that one of the most valuable fish species that farmers like is among the smallest, *Barbus* spp. The farmers would find it easy to grow and there is someone in the area already with this fish. Nobody has seriously considered this fish for aquaculture.

JAMU: From the literature which was reviewed, no one has looked at this small *Barbus* sp. in pond conditions.

MSISKA: I understand that somebody tried to work on *Barbus* in Asia according to R.S.V. Pullin (pers. comm.), but did not succeed to control its entire life cycle. *Barbus* is indeed a very interesting fish, but again apart from its taxonomic status, little is known about it.

CHIMATIRO: Catfish are quite plentiful around Zomba but few people associate them with culture, although the majority like the fish. Towards the end of my research some farmers said

[1]Pauly, D. and J.L. Munro. 1984. Once more on the comparison of growth in fish invertebrates. Fishbyte 2(1):21.

that they would try out catfish in place of carp. We tried giving catfish, of course without committing ourselves that catfish was an alternative to carp.

MKOKO: Previously there was a preference for carp but with a shortage of water, an opportunity has arisen whereby people are more open to any fish except for religious reasons. That seems to be the general observation.

RASHIDI: Why is it that prices seem to be lower for catfish?

NOBLE: There was a very small sample size of catfish compared to others. Most farmers catch only three or four wild catfish in their ponds plus *Barbus* spp. at harvest. It may be more than K2.00 per kilogram.

MKOKO: In selecting possible candidates for aquaculture, apart from growth, what other characteristics do you look for?

JAMU: When going through this list we were mainly interested in adult diet; as a result you find that there are no predators in the list. Most of the fish are feeding on snails, insect larvae, benthos and plankton. Maximum size was the other characteristic considered in a preliminary selection criteria. A step ahead of this would be to calculate the ϕ' value, as Msiska and Costa-Pierce have done for *O. karongae* (*saka*). But this requires a select population grown in ponds for a sufficiently long period. This list also considered the type of vacant niches and whether or not the fish can reproduce in ponds. Above all, this selection list is not meant to be exhaustive.

AMBALI: Catfish has been regarded as an alternative species to common carp. If you are able to get about 41,000 fingerlings or fry, why don't you distribute them to farmers as a source of income?

MSISKA: Those who have read about *Clarias gariepinus* will realize that although it is very easy to induce the fish, it is not so easy to grow the fry and I suspect this will be true with *Bathyclarias loweae*. In *Cl. gariepinus* it has been very clearly shown that the young ones devour each other if there is an assortment of sizes in confinement. We bred *B. loweae* artificially but most of them died and the cause was not diagnosed.

NOBLE: I was interested that you had tiger fish as one of the candidate fish species. I would suggest that Upper Shire and Lower Shire have plenty of tiger fish. I don't think we want tiger fish to get into Lake Malaŵi catchment areas?

MSISKA: In fact, it is not a tiger fish, it is a *mbuna* (*Tremachromus* spp.).

COSTA-PIERCE: Why did you restrict your candidate species to Lake Malaŵi? As you know, a lot of fish species in the world like the Chinese carps are also found in rivers. The Indian major carps are found in rivers. I would like to know why you didn't choose from the candidates from the Lower Shire or the other rivers in Malaŵi, like the Bua River?

MSISKA: Your observations may not be entirely correct. Most of our fish tend to be from Lake Malaŵi; however, they are migratory. One does not know whether the fish is riverine or lacustrine. Some of them migrate quite way up rivers and are thus not restricted to one environment. In the Lower Shire River we have *Clarias gariepinus* and *Cl. ngamensis* which seem to have good characteristics but apart from these there are not many fish in the Lower Shire. There are about 30 species, most of them resembling those of the Zambezi River basin. There is a big one belonging to the catfish family (*Heterobranchus longifilis*) and *Oreochromis placidus* which have been included in the list. Other water bodies especially river systems are not well known for their fish.

COSTA-PIERCE: How many species of *Labeo* are there in Malaŵi?

MSISKA: In the Lower Shire there are at least three (*L. altivelis, L. congoro, L. cylindricus*); in addition, Lake Malawi has two (*L. cylindricus* and *L. mesops*).

MKOKO: Suppose reasonable resources are available, what time frame would we need in order to replace carp, if the decision were made to eradicate it?

RASHIDI: There is a lot yet involved. We have to identify these fish first, like now, *O. karongae* (*saka*) is difficult because of the various strains within the species. After you have got them sorted out you have to get the fish to breed in ponds. Until you are sure that the fish will be able to grow and breed in shallow ponds, you cannot say anything exact about the fish, and that may take up to three years.

DICKSON: If you are talking of a substitute for common carp then we should be talking of something similar to that fish. It is something quite different in fish farming extension if you are using fish species which are bred on the station and distributed to farmers and fish which farmers themselves breed. Maybe *Bathyclarias loweae* is closer to carp but it might take longer to develop.

MSISKA: When transferring species from one area to another we may be transferring diseases as well, so we need to formulate good protocols. I, for instance, have noticed that with some *O. karongae* (*saka*) we transferred *Ichthyophthirius multifilis* to the research station. With *Labeo mesops* we noticed what was very similar to abdominal dropsy, a complex viral bacterial disease of carp. Therefore we should not just be preoccupied with growth and reproduction. We have to consider a complete list of selection criteria and have to proceed systematically and scientifically.

COSTA-PIERCE: As long as the protocols are worked out by scientists and other people who have thought deeply about the issue, the procedures are simple. Literature searches may also exclude some groups of fish. If a scientific group acted quickly on protocols and transportation methods, which are now popularly known, I think that growth and reproduction potential in ponds might be assessed by a couple of years. We need options so that we give each of these species a good chance. The door should not be completely shut but left open so that if we do this work and find no suitable fish we can still go back to look for alternatives, even exotics if necessary at the time.

VAN DAM: There is an immediate need to know how much work has been done on some of these fish. There is already a lot of work on both growth and breeding. We can relieve ponds of *O. shiranus* of which we already know so much about.

SAULOSI: There is a fish called *thamba* (*Barbus litamba*) which is doing very well in Kamuzu Dam, maybe this can be tried too!

MKOKO: The fish is just tasteless.

Working Group Reports

Working Group I

Continuation of Common Carp Production in Malaŵi

Dr. B.A. Costa-Pierce
Chairperson

In support of common carp introduction to Malaŵi, a group formulated an action plan for the government if it upholds the recommendation to continue with carp. The group recognized the need for securing official support as a prerequisite for expanding production of this fish in Malaŵi because the existing permit restricts carp production to a certain geographic zone in Malaŵi. If continuation is approved to broaden the genetic base of the fish species, two more importations from the USA and Europe were suggested before an expansion of a carp distribution program is undertaken.

The group postulated that a stressed aquatic environment might provide an opportunity for common carp to proliferate. Therefore, other predisposing factors such as the presence of alien predatory fish, overfishing and water quality changes arising from degraded catchment areas of Malaŵi may favor the spread and establishment of carp.

Advantages of Continuation of Common Carp

- Common carp is one of the best growing fish in the world and most characteristics have been proven through research and have been established genetically.
- The fish is a culinary delight to both farmers and consumers.
- When considering its growth and production performance in aquaculture systems, carp is sometimes described as a "biological miracle".
- Common carp occupies a niche in Malaŵian ponds that no other farmed fish occupies.
- If Malaŵi were to continue common carp, there is evidence that aquaculture development would accelerate.

Disadvantages to the Continuation of Common Carp

- Environmental degradation might follow introduction of common carp especially in habitats which have other predisposing factors such as overfishing, siltation and alien predatory fishes, e.g., black bass.
- Where consumers prefer small fish, common carp may prove unattractive because it grows to a large size and is more expensive.

Plan of Action

Research

a) Research should emphasize environmental assessment of common carp in various water systems where it is believed to have escaped into the wild. In order to simulate these environments in on-station experiments, two approaches were suggested:
   - environments associated with catchment areas where common carp has escaped should be monitored regularly; and
   - a pond of about 1 ha should be set aside for on-station research such as studying the impact of stocking carp in the presence of food fish and fish predators such as *Serranochromis robustus*.

b) International research collaboration should be initiated through regional groups such as SADCC, CIFA and ICLARM; thereafter a conference to be convened on impacts of fish exotics at a venue most appropriate for the topic, i.e., Zimbabwe (the "home" of exotic fish in SADCC!).

Extension

a) A national awareness program is required to ensure that every Malaŵian gets to know the attributes of common carp.
b) Within designated areas which research should help to define, farmers should be encouraged to raise common carp so that production can be expanded.
c) In order to ensure adequate stocking supplies, appropriate hatchery techniques should be popularized so that farmers are self-sufficient in fingerlings in rural areas.

Legal Framework

The presence of common carp in Malaŵi requires strong legal support and existing regulations need to be strengthened in light of research findings.

Working Group II

Total Ban on Common Carp Production in Malaŵi

Mr. O.V. Msiska
Chairperson

Discussions of this group focused on the merits and demerits of immediately instituting a national ban on common carp. Only 36 smallholder farmers and two estates are recorded to have been engaged in raising common carp in Malaŵi. On the other hand, the majority of fish farmers (ca 1,000) remain unaffected by carp and enthusiasm for fish farming is evident all round, irrespective of the fish species.

Advantages of a Ban

a) Research and development efforts could in the future concentrate on fish farming technologies for indigenous species for which little is known.
   - There will be an opportunity for publicizing local species which may not have been accorded appropriate status in past development.
   - Local consumer awareness of the produce need no longer be an issue because of an already existing familiarity.
   - If sufficient production is achieved, it could give rise to special local cuisines, thereby creating other avenues of economic activity. For various reasons, including small quantities and unfamiliarity to consumers, common carp never made it into local restaurants.

b) Possible negative environmental and socioeconomic impacts on other fish arising from alien fish introductions will be averted.
   - Local fish species and ecosystems will be spared competition with exotics, and the unique features of Malaŵian fish will be maintained.
   - The ban will save Malaŵi from the possible embarrassment of being associated with fish introductions (which may adversely affect indigenous fish fauna) as has happened with Nile perch in Lake Victoria. Such an introduction may prove unpopular with other members of SADCC in which Malaŵi is the Coordinator for Inland Fisheries. Malaŵi should assume a leadership role in fish conservation.
   - Culturally influenced, socioeconomic issues including size preferences which are so important among smallholders become transparent once market distortions from exotics are removed.

c) The existing legislation on introduction of exotic fish species to Malaŵi is sufficiently foresighted and should be upheld. The reasons for instituting it are now more apparent than before, but need to be supported by hard data.

Disadvantages of a Ban

a) Once the ban is formally accepted, there will be a loss of income to those farmers who have become accustomed to raising common carp and those who derive a significant portion of their farm earnings from this fish.
b) Interest among fish farmers may drop where common carp is the sole incentive for going into fish farming.
c) Depending on how the ban is arranged, there might be a loss of confidence by farmers in the extension services of the Fisheries Department.

Plan of Action

Research

Once common carp is banned there will be a stronger need to mobilize effort (financial, human and institutional) to tackle constraints undermining the development of indigenous fish species like *Bathyclarias* spp., *Oreochromis karongae* (*saka*), *Clarias gariepinus*, etc. A tentative time schedule suggested by the group for completion of research of these fish was outlined as follows:

Clarias gariepinus	:	ready for immediate propagation and distribution
Oreochromis karongae (*saka*)	:	2 years
Bathyclarias spp.	:	3-5 years
Barbus spp.	:	2-3 years

Extension

The group recommended that with immediate effect, before farming systems information is developed for lesser known fish species, a literature search be conducted on *Clarias gariepinus*. Adequate research has been conducted both locally and internationally on this fish to compile a technology package for immediate dissemination.

In the event that common carp will continue to be withheld from fish farmers, extensionists should engage in confidence building with farmers who may have become despondent by supplying them with other fish species to grow. In addition to creating good rapport, this would prevent them from negatively influencing their colleagues.

Evaluation and Monitoring

Due to inadequate documentation on income changes, dropout and uptake rates of fish farmers, it was recommended that future efforts be made to collect relevant baseline data to provide management decisions. Where possible, it is necessary to delineate clearly the effect of common carp or other introduced fish species.

The Malaŵi Fisheries Department, the Department of Research and Environmental Affairs, ICLARM, the Northern and Central Regions Fish Farming Project and the University of Malaŵi should collaborate on all or some aspects of activities proposed.

Working Group III

Phased Withdrawal of Common Carp in Malaŵi

Dr. R.P. Noble
Chairperson

The group discussed a system of phased withdrawal of common carp with a view to bringing about its complete eradication. It was reported that only 10% of the farmers in East and West Zomba have been involved in carp farming and, in terms of the number of farmers, Zomba has been the main carp producing district. It was thus recommended that the fish should remain in the area for at least one growing season pending final eradication in 1992. Similarly, two estates that were allowed to raise carp should do so for only one more year. Distribution to smallholders would involve 3,000-4,000 fingerlings to about 30-40 farmers who have proven themselves capable of handling wisely the exotic fish.

Meanwhile, Fisheries Department and allied projects should enter into a dialogue with farmers about eventual carp withdrawal pending the introduction of other fish species which are environmentally acceptable.

Advantages of Phased Withdrawal

- This approach to carp withdrawal will help maintain good relations between the Fisheries Department and farmers, allowing extensionists to operate effectively in the area.
- Phasing the withdrawal of carp will allow those concerned with its replacement time to consider other options.
- In order to monitor and evaluate some of the implications of carp introduction, a phased withdrawal will allow collection of neglected data. Similarly, farmers' attitudes and how they adjust to changes in their farming systems will be assessed for the benefit of future programs.

Disadvantages of a Phased Withdrawal

- Despite assurances that carp will be replaced, farmers might feel cheated because there is no known fish which might fit exactly into its niche.
- Lack of an immediate replacement package will create apathy among farmers which may only be prolonged through phasing its withdrawal.
- Lack of proper policing measures may result in exposing more fish to the risk of them escaping into the natural environment.

- Dependence on seed supply from the Domasi Station retards farmer progress as it does not make them self-sufficient in feed supplies. Phased withdrawal of carp will simply perpetuate the *status quo*.

Plan of Action

Research

- When considering a program of study for new fish species, on-farm propagation trials should be included to make farmers independent of government agents.
- A list of potential candidate fish species should be made after an exhaustive search before long-term commitments are made in research and development.
- In order to solicit ideas from farmers on which fish and farming systems to adopt, use should be made of participatory research methods.

Extension

- The Fisheries Department was urged to police the eradication of carp during the eradication phase in order to be certain that all the fish have been destroyed.
- Fisheries and others involved in the extension service should produce adequate fingerlings of *Clarias gariepinus* for distribution.
- In the next round of distribution, common carp should be given to only the few farmers (30-40) who have proven competent and can prevent any escape into the natural environment.

International Cooperation

Since common carp has been reported to have escaped into the Lake Chilwa catchment basin and Lower Shire River system, countries bordering these areas should be involved in assessing its environmental effects.

Final Workshop Verdict on Common Carp

After deliberations on the status of common carp in the natural and artificial waters of Malawi, a final vote was cast by the members of this workshop to put the matter to rest.

Results of the Vote

14 out of 20 were against the continuation of carp;
2 were for phased withdrawal;
2 were for the continuation of carp;
2 did not vote.

List of Participants

Dr. E.A. Allison
SADCC Pelagic Fisheries Project
Box 311, Salima, Malaŵi

Mr. A. Ambali
Chancellor College
Box 280, Zomba, Malaŵi

Mr. M.C. Banda
Monkey Bay Fisheries
Box 27, Monkey Bay
Malaŵi

Mr. F.J. Chikafumbwa
ICLARM/GTZ Africa Aquaculture Project
Box 229, Zomba, Malaŵi

Mr. S.K. Chimatiro
Zomba Fisheries
Box 206, Zomba, Malaŵi

Dr. B.A. Costa-Pierce
ICLARM/GTZ Africa Aquaculture Project
Box 229, Zomba, Malaŵi
(Present address:
Mauna Loa Research Institute, 6 Hale Ohia Road
P.O. Box 1050, Volcano
Hawaii Island 96785, USA)

Dr. M.W. Dickson
EEC Project
Box 700, Mzuzu, Malaŵi

Dr. T. Gloerfelt-Tarp
MAGFAD
Box 206, Zomba, Malaŵi

Mr. D.M. Jamu
ICLARM/GTZ Africa Aquaculture Project
Box 229, Zomba, Malaŵi

Ms. M. Kapalamula
Domasi Fisheries
Box 44, Domasi, Malaŵi

Mr. E. Kaunda
ICLARM/GTZ Africa Aquaculture Project
Box 229, Zomba, Malaŵi

Mr. S.C. Khupe
Domasi Fisheries
Box 44, Domasi, Malaŵi

Mr. J.S. Likongwe
Bunda College
Box 219, Lilongwe, Malaŵi

Mr. C. Makawa
EEC Project
Box 700, Mzuzu, Malaŵi

Mr. A.O. Maluwa
EEC Project
Box 700, Mzuzu, Malaŵi

Mr. S.A. Mapila
Fisheries Headquarters
Box 593, Lilongwe, Malaŵi

Mr. B.J. Mkoko
Fisheries Headquarters
Box 593, Lilongwe, Malaŵi

Mr. O.V. Msiska
Department of Research
and Environmental Affairs
P.O. Box 30745, Lilongwe, Malaŵi

Dr. R.P. Noble
ICLARM/GTZ Africa Aquaculture Project
Box 229, Zomba, Malaŵi

Mr. B.B. Rashidi
Mzuzu Fisheries
Box 700, Mzuzu, Malaŵi

Mr. B.B. Saulosi
Domasi Fisheries
Box 44, Domasi, Malaŵi

Mr. D.C. Sikawa
Mzuzu Fisheries
Box 700, Mzuzu, Malaŵi

Mr. A. Van Dam
ICLARM/GTZ Africa Aquaculture Project
Box 229, Zomba, Malaŵi

History, status and future of common carp (*Cyprinus carpio* L.) as an exotic species in Malawi.
O.V. Msiska and B.A. Costa-Pierce, Editors. 1993. ICLARM Conf. Proc. 40, 28 p. Saddle-stitched, 18 x 25.5 cm. ISSN 0115-4435, ISBN 971-8709-37-1. US$3.50 airmail, $1.50 surface, ₱37.50.

Titles of Related Interest

Culture of common carp in floating net cages.
B.A. Costa-Pierce, Rusydi, A. Safari and G.W. Atmadja. 1989. ICLARM Educ. Ser. 7, 42 p. Saddle-stitched, 21 x 16.5 cm. ISSN 0116-5720, ISBN 971-1022-72-9. US$2.50 airmail, $1 surface, ₱20.

A small-scale hatchery for common carp.
B.A. Costa-Pierce, Rusydi, A. Safari and G.W. Atmadja. 1989. ICLARM Educ. Ser. 8, 42 p. Saddle-stitched, 21 x 16.5 cm. ISSN 0116-5720, ISBN 971-1022-73-7. US$2.50 airmail, $1 surface, ₱20.

A hatchery manual for the common, Chinese and Indian major carps.
V.G. Jhingran and R.S.V. Pullin. 1988. Second Edition. ICLARM Stud. Rev. 11, 191 p. Perfect binding (paper back), 28 x 21.5 cm. ISSN 0115-4389, ISBN 971-1022-17-6. US$15 airmail, $7.50 surface, ₱100.

Environment and aquaculture in developing countries.
R.S.V. Pullin, H. Rosenthal and J.L. Maclean, Editors. 1993. ICLARM Conf. Proc. 31, 359 p. Perfect binding (paperback), 18.5 x 26 cm. ISSN 0115-4435, ISBN 971-8709-05-3. US$15 surface, $22 airmail, ₱350.

HOW TO ORDER

Enquirers from the USA should order directly from our exclusive distributor, the **International Specialized Book Services**, 5804 N.E. Hassalo St., Portland, Oregon 97213-3644, to whom payment should be directed using the ***airmail*** price. Interested persons in Canada and Central and South America may also find ISBS a convenient source.

Enquirers in Europe may order from **Ernst S. Toeche-Mittler GmbH**, Versandbuchhandlung, Hindenburgstrasse 33, D-6100 Darmstadt, Federal Republic of Germany, using the ***airmail*** price.

Enquirers from the Philippines may use the peso price and order directly from: ICLARM, MCPO Box 2631, 0718 Makati, Metro Manila, Philippines; or from our headquarters at Bloomingdale Bldg., 205 Salcedo St., Legaspi Village, Makati, Metro Manila, Philippines.

Enquirers elsewhere should address orders and payment (payable to ICLARM) in US$ by international money order, bankdraft or UNESCO coupons to: The Editor, ICLARM, MCPO Box 2631, 9718 Makati, Metro Manila, Philippines. We can accept US$ checks only if from a US-based bank due to high clearance fees of other banks.

Airmail is strongly recommended due to delays of up to six months and occasional losses experienced with surface mail.