A collector well in the Chivi communal area
(Photo by Bruce Campbell)

Chapter 16

Community management of the Lower Guinea Rainforest ornamental fishery

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Since September 2000, the WorldFish Centre has been studying the biogeography and ecology of Lower Guinea Rainforest rivers in southern Cameroon. A comprehensive review of the literature was published by Brummett and Teugels in 2004, and upon that base a series of field research projects have endeavoured to further characterize rainforest streams in terms of biotope and species diversity and abundance.

In partnership with the Organization for the Environment and Sustainable Development (OPED), a local nongovernmental organization, four rainforest communities are being engaged in an effort to improve the efficiency and sustainability of river exploitation and management. The ultimate goal of this work is to establish functional village-based monitoring and management programmes that ensure the sustainability of commercialized and diversified natural resource exploitation. This chapter summarizes findings to date and progress on the implementation of a socially, economically and ecologically sound ornamental fishery business and management plan for Lower Guinea Rainforest rivers.

Rainforest rivers

The Lower Guinea Rainforest extends over 500,000 km^2 (Mahé and Olivry 1999) in an arc along the northeastern corner of the Gulf of Guinea from the Cross River in the northwest to just short of the Congo in the southeast. It includes some 50 major and minor rivers.

Unlike the uplifting and rifting that affected eastern and southern Africa during the Miocene, the river courses in central Africa are extremely ancient, having not been substantially disrupted since the Precambrian (Beadle 1981; Peyrot 1991a). The Lower Guinea Ichthyological Province corresponds closely with the extent of humid forest refugia during the last dry phase of the continent, 20,000–15,000 years BP (Maley 1987; Schwartz 1991) and is similar to the distribution pattern of aquatic molluscs in the region (Van Damme 1984). It seems likely that a more broadly distributed group of archaic taxa related to the modern species in the Lower and Upper Guinea provinces were repeatedly and/or progressively isolated during the several dry phases that reduced the extent of rainforest between 70,000 years BP and the present (Lévêque 1997), creating ideal conditions for both the preservation of archaic taxa and allopatric speciation.

Most Lower Guinea rivers are 'blackwater', with a mean pH between 5 and 6 and electrical conductivity between 20 and 30 µS/cm. Water temperature is always between 20° and 30°C. The water in these rivers is clear and tea-coloured as a result of the low dissolved nutrient concentration, low light (due to narrowness of valleys, canopy cover and often cloudy skies) and the large amount of allochthonous vegetative matter that falls or flushes into the water from the surrounding forest. Most of the larger rivers have a bimodal discharge pattern. In general, the magnitude of fluctuation is greater in the north (up to 8m on the Lower Cross); in the southernmost extent of the province, the partially spring-fed Niari and Nyanga exhibit minimal seasonality of flow (Peyrot 1991b).

Fish biodiversity

In a review of West African riverine biodiversity, Hugueny (1989) found a strong correlation between species richness, watershed area and river discharge volume. Using these relationships, one finds that the fish fauna of the Lower Guinea Ichthyological Province's rivers are disproportionately rich in relation to the sizes of the watersheds (Teugels et al. 1992). For example, the Cross River, with a watershed of 70,000 km^2, has an estimated 166 species (1 sp/421 km^2), and the Nyong River has a watershed of only 28,000 km^2 and contains 107 species (1 sp/262 km^2). On the other hand, the Niger River, with a watershed of 1,100,000 km^2, has 254 species (1 sp/4,331 km^2). The Bandama, a rainforest river in Côte d'Ivoire with a drainage basin of 97,000 km^2 but with a fauna similar to that of the Nilo-Sudan, has only 95 species (1 sp/1,021 km^2) (Hugueny and Paugy 1995). Even the Congo River, with a watershed of 3,550,000 km^2 and a very stable flow regime that has existed for at least 3 million years (Beadle 1981), has only 690 species (1 sp/5,145 km^2), although that figure is based on very inadequate sampling and will likely be raised upon further exploration.

From the available literature, 23 families, 123 genera and 527 species have been reported from the Lower Guinea Ichthyological Province (M. Stiassny, American Museum of Natural History, pers. comm., April 2005). Apart from the large number of small cyprinodonts (of which 60 percent are from the genus Aphyosemion), the freshwater fauna is dominated by the Siluriformes (7 families, 22 genera, 103 species), the Characiformes (2 families, 18 genera, 52 species), the Cichlidae (20 genera, 73 species), the Cyprinidae (10 genera, 81 species) and the Mormyridae (15 genera, 41 species).

Endemism in rainforest fishes seems to be relatively high (Teugels and Guégan 1994), although it is very difficult from the scanty documentation to determine exactly how many of the single reports for a species are due to endemism, lack of adequate distribution data or simple misidentification (Stiassny 1996). In particular, the Cyprinodontiformes are prone to endemism, with some species occupying only a few hundred square meters of bog or an isolated creek. These small fishes, of which there are 122 described species in the province, account for a substantial portion of the overall species richness.

Some fishes move up and down the river according to their reproductive seasonality. Cyprinids and Citharinids, in particular members of the genera *Labeo* and *Distichodus,* are reported by fishing communities in the Upper Cross and Ntem rivers of Cameroon to undertake spawning runs during the latter part of the long rainy season (October–December), when rivers are swollen and marginal forests are flooded, providing cover and food for larvae and fry (Lowe-McConnell 1975; du Feu 2001). The result is that species diversity measured over the year changes substantially according to which fishes are moving upstream or down at any particular point in time (Lowe-McConnell 1977).

The high fish biodiversity in the Lower Guinea forests is probably the result of three main factors: (1) the relative stability of the hydrological regime in these rivers since the Eocene (compared with the Nilo-Sudan zone); (2) the highly sculpted nature of the watershed (compared with both the Congo and the Nilo-Sudan zones); and (3) the large number of microhabitats created in rainforest rivers by the forest itself.

Current exploitation

Welcomme (1976) estimated the total number of first-order rainforest streams at more than 4 million, with a combined total length equal to half of all watercourses in Africa, making these the largest single riverine ecosystem on the continent (Figure 16-1).

Of the 8 million people who live in the Lower Guinea forest, 20 percent are more or less full-time fishers and another 70 percent (mostly women and children) fish seasonally. Estimates from Cameroon put the productivity of capture fisheries in forest river basins at 0.5 tons/km^2/yr (Mdaihli et al. 2003), or 260,000 tons for the entire forest. At the local wholesale price for fresh foodfish of approximately US$2/kg, the cash value of the fishery exceeds US$500 million per year.

Figure 16-1. Typical first-order stream exploited for ornamental fishes in Kribi-Campo area of southern Cameroon

Fishing in rainforest rivers is severely constrained by the large quantities of wood in the streambed. By far, the most common types of gear are passive set nets, traps and hook lines, which vary greatly in accordance with the diversity of the fish fauna. Also common is a hook-and-line fishery dominated by small children and mainly targeting immature cichlids.

Fishing communities have learned to take advantage of spawning runs by constructing mesh barriers of tree trunks and branches, bound together by vines and held in place by large stones. At the height of the rains, these structures are submerged and gravid adults pass easily over them. After spawning and spending several months upstream, foraging in the flooded forests, the fish head downstream. However, by this time the water levels have declined and the adults find themselves trapped by the barrier. Juveniles apparently pass through the mesh without problem.

In Cameroon, reproductive migrations *(doks)* take place as waters rise in May and October. Doks involving *Labeo batesii* and *Distichodus* spp. have been documented in the Upper Cross and the Ntem, respectively. They typically last no more than a few hours or days. According to du Feu (2001), who interviewed fishers on the Upper Cross River, the village is alerted to the imminence of the spawning event by the upstream movement of fish. Two hours after the fish have passed, the water turns white with milt, at which time the villagers set nets to block the return of spent adults on their return downstream. Men do the fishing with cast nets or even clubs, while women clean and smoke the catch. Spawning sites, when known and sufficiently circumscribed, are generally protected or exposed to only limited exploitation (e.g., restricted access and/or gear).

At least two traditional fisheries are allocated entirely to women. One, the *alok,* involves the construction of small earthen dams across first-order forest streams during the dry seasons (January–April and July–August) to capture small Channids, Clariids and Mastecembelids (van Dijk 1999). As water levels decline, the dams prevent fish from migrating downstream. When the water gets low enough, the women wade in and harvest the remainder, catching the fish by hand or with the help of baskets. This practice is widespread in both the Lower Guinea and Congo ichthyological provinces and adds substantially to the protein intake of forest communities. Another fishery that is the exclusive domain of women is the use of woven basket traps *(aya)* to catch the freshwater prawn, *Macrobrachium vollenhovenii*.

Perhaps just five exporters currently dominate the limited trade in ornamental fishes coming from Cameroon. In general, the global average retail price for ornamental fishes is around US$1.8 million per ton, compared with about US$15,000 per ton for foodfish (Tlusty 2002). A small number of middlemen based in the commercial capital, Douala, leave orders for fish with the fishers, who then enlist the assistance of village women and children to fill the orders. Buyers generally provide basic equipment, including plastic bags, for holding. Captured fish are typically held in tanks in Douala for a period of days prior to packing and shipping by air to Europe, where the poor handling they endure often results in mortalities up to 85 percent (C.H. Eon, DVM, Clinique vétérinaire de la Garenne, Langon, France, pers. comm.). Fishers typically negotiate prices individually. Prices realized by the fishers through these ad hoc arrangements are low, averaging US$0.10 per fish, or less than 5 percent of the wholesale price received by the buyers.

There are six principal collecting sites for ornamental fishes in Cameroon: the Munaya River, a tributary of the Cross, fished near Mamfé; Lake Barombi-Mbo, a volcanic crater lake known for its endemic fishes of the family Cichlidae; Muyuka/Moliwe and similar streams on the eastern slopes of Mount Cameroon; the Dja River, part of the upper Congo River basin, near the town of Sangmelima; the Ntem River, fished from the towns of Ebolowa and Campo; and Kribi, where the WorldFish-OPED joint initiative is currently most active. In the Kribi area are four rivers important to the ornamental fish trade within an area of approximately 400 km^2: Kienké, Lokoundji, M'polongué and Lobé.

Access to any of these fisheries is traditionally regulated by village leaders. Such management techniques as protecting spawning areas and the prohibition of certain gears and seasons are traditionally enforced through the use of magic charms, or *ju-ju.* Members of the village are free to fish as long as they follow the basic regulations. Visiting fishers, of which there are considerable numbers (an estimated 80 percent of fishers on Cameroonian rivers are Malian or Nigerian) must first seek permission from the village leadership and then pay a token fee, normally in the form of palm wine or a percentage of the catch.

Threats to the resource

Increasing population and poverty coupled with low valuations of rainforest biodiversity are leading causes of habitat destruction and overexploitation (Stiassny 1996). Alien species (especially *Oreochromis niloticus, Clarias gariepinus* and *Heterotis niloticus*), introduced for aquaculture and accidentally released into the Nyong River, have contributed to the disappearance of several indigenous species from commercial catches. Careless use of insecticides such as Lindane and Gammelin 20 on the increasing number of small-scale oil-palm plantations in the area is cuasing spills and runoff that, according to fishers, have left some streams devoid of fish for up to 15 years. In addition, the use of these poisons specifically to catch fish has become increasingly frequent. Human deaths have been reported as a result of eating poisoned fish, and on the Ntem River in southern Cameroon, insecticide fishing appears to have disrupted local aquatic ecosystems to the point where the electric catfish, *Malapterurus electricus,* has been able to extend its habitat into small rivers where it was previously not found. Because of the powerful shocks emitted by this fish, women have in some areas been forced to abandon their traditional dam fishing.

The greatest threat, however, comes from irresponsible logging. Cameroon has one of the most thorough forest management laws in Central Africa, but regulations are seldom enforced. The Lower Guinea has already lost an estimated 46 percent of its forest cover to logging and conversion to agriculture, and it continues to lose forested watershed at an average rate of 7 percent per year (Revenga et al. 1998). In the process of removing the valuable timber, these (often illegal) logging operations also expose large amounts of bare earth and alter stream courses, increasing runoff and siltation. Road construction, sawmills and other infrastructure associated with logging attract people into the forest, transforming the ecosystem (Burns 1972; Garman and Moring 1993). Kamdem-Toham and Teugels (1999) list the changes that occur in and around the rainforest rivers in the Ntem River basin as a result of poorly managed logging operations:

» absence of forest canopy above streams;
» heavy siltation;
» abundant primary production (algae);
» uniform watercourse, lacking riffles, with pools the dominant habitat type; and
» no cover or shelter for fish.

In terms of water quality, those changes in habitat have reduced water clarity and dissolved oxygen and raised temperature and conductivity. In undisturbed sites, water was clear brown with a mean temperature of 23.5°C, dissolved oxygen was 2.5 to 4.2 mg/l (measured at noon), and electrical conductivity was 20 to 30 µS/cm. In sites affected by logging, the water was cloudy with a mean temperature of 34°C, dissolved oxygen was less than 1.0 mg/l, and average electrical conductivity was 48 µS/cm (Kamdem-Toham and Teugels 1999). Changes of this magnitude wreak havoc on aquatic life and may last for many years (Growns and Davis 1991).

Currently, fishing communities have limited regulatory authority over the rivers they fish. Some traditional rules apply, but these are easily and often used to create inequalities by absentee leaders who exert their influence through proxies. Logging companies have found easy opportunities to exploit timber without regard for local communities or the integrity of the forest and the associated riverine ecosystem upon which the people depend for their livelihoods.

Socioeconomic and environmental sustainability

Sustainable management systems depend upon users' appreciation of the value of natural resources and willingness and ability to conserve them over the long term (Sheil and Wunder 2002). The will to properly manage the rainforest depends in large part on the degree to which the revenues of forest resource exploitation accrue to local populations, coupled with a sense of ownership and enforcement of a sustainable management plan.

From the point of view of indigenous people, timber may not be the largest potential source of local income (Peters et al. 1989), but since timber companies have already made substantial investments in equipment, infrastructure and market development, large-scale tree exploitation offers a comparative advantage in terms of short-term profits. Also, such profits accrue at a level and in a way that make them more accessible to tax collectors. A similar logic applies to large- versus small-scale capture fisheries and, hence, the continued presence of foreign fishing fleets off the coast of Africa at a time when local fishing communities are suffering from extreme poverty and declining catches. In contrast to these large-scale operations, the value of most nontimber forest products and artisanal fisheries accrues locally and in a dispersed manner that makes accounting and taxation virtually impossible (see Chapter 15, this volume).

However, it has been shown that small businesses can produce wider economic growth and prosperity per dollar invested than larger enterprises. Delgado et al. (1998) reviewed results from Burkina Faso, Niger, Senegal and Zambia and found that even small increments to rural incomes that are widely distributed can make large net additions to growth and improve food security. Winklemann (1998) identified interventions that lead to improved incomes at the level of the rural resource manager as having a larger impact on countrywide income than increases in any other sector. Governments interested in fighting rural poverty should seriously consider how smaller-scale investors can be brought to the fore in their natural resource exploitation strategies.

Fisheries for the poor

From the point of view of rural communities, directly confronting the timber and large fishing companies over ownership of resources is an uphill task. For artisanal fishers who are being required to increase mesh sizes and respect closed seasons, watching even small trawlers take several tons of fish with a single haul seriously undermines the credibility of regulators, whether local or national and whether the fish stocks are related or not. In fact, rather than struggling to protect remaining resources, local fishing communities confronted with expropriation have often joined in the ravaging of their own resources to capture whatever profit they can before the big companies arrive.

A first step in revaluing forest resources and enforcing sustainable management is the quantification of the biodiversity in question. For fish, several attempts have been made at the generation of a workable index of biotic integrity, such as that used to track changes in temperate zone streams, but parameterization has been a problem. The best effort to date in Central Africa is that of Kamdem-Toham and Teugels (1999), but gaps remain. Existing datasets on aquatic biodiversity and ecology in Central Africa are weak, at best, and this makes it very difficult to develop quantitative tools (Lévêque 1997).

Coupled with this quantification and valuation exercise should be the development of improved management and exploitation strategies that could actually increase the value of aquatic ecosystems and justify their preservation while improving rural livelihoods. Forest river ecosystems are currently unmanaged and unregulated in any formal sense. ~~The~~ Department of Fisheries in Cameroon ~~does~~ not even have a policy or planned programme of work on riverine ecosystems, except for a few small dams (M.O. Baba, Director of Fisheries, Yaoundé, pers. comm., April 2002). The most widely promoted method of increasing the productivity of aquatic ecosystems in Central Africa is to increase fishing pressure through the introduction of subsidies on motors and other fishing equipment, but this is done without any clear idea of the size of the resource or level of current exploitation.

Although some increased pressure might be warranted in some areas, the upper limit for this strategy is probably already in sight for most places. Careful regulation of fishing gear and seasons based on scientific data might be a more widely applicable strategy for increasing catches of certain species in some rivers. The greatest potential for improving profitability while conserving ecosystems might lie with species of value as ornamental aquarium fishes. These are unusually abundant in African rainforest rivers and wholesale at an average of US$2.43 per fish. Keeping prices high and availability low is ~~the~~ poor organization of the fishery, which creates scarcity and nullifies any possible economies of scale. Also significant from the point of view of local investors is that the large commercial breeders in Singapore and Florida find it difficult or impossible to get forest river fishes to reproduce, most likely because outside the special and complex rainforest ecosystem, these fishes seldom reach sexual maturity.

To investigate the potential for commercially viable and environmentally sustainable ornamental fisheries, WorldFish and OPED have initiated a series of activities aimed at the development of community-level exploitation and management of ornamental fishes in the Kribi-Campo area of southern Cameroon. Although the initial project is focusing on Cameroon, the results should be immediately relevant to many of the countries in the Lower Guinea forests. In addition, a similar style of commercial exploitation based on additional ecological data collection and monitoring could be adopted in the Congo Basin.

Community-based fisheries management

Adaptive collaborative management (ACM), in which communities take ownership of natural resources and undertake to sustainably manage them, is an emerging concept used in several places (Bennum et al. 1995). By transferring management and enforcement to local communities, ACM aims to increase control over natural resources while reducing central government expenditures. ACM of freshwater capture fisheries is currently being tested in some African countries (Khan *et al.* 2004). To date, the track record of community management and conservation interventions is mixed, but new knowledge about how and why they might be made to work better and the time frames involved is encouraging (Hulme and Murphree 2001).

The typical problem facing small-scale natural resource businesses is competition with unregulated poachers and larger-scale investors once markets are developed and the profitability of a product demonstrated (Sunderland and Ndoye 2004). A recent survey of low-order forest rivers in southwestern Cameroon (Table 16-1) found that the total value of the ornamental fishes in the wild at any of the sites sampled would be insufficient to support a significant expansion of the exploitation rate. Most of these species have very low fecundity and cannot be expected to rapidly repopulate heavily exploited streams (Kamdem-Toham and Teugels 1998). Even if the resource could support a total annual removal or replacement of the stock, only a few pristine sites within Korup National Park could return more than a few hundred dollars in annual revenue to villages.

On the other hand, if capture is augmented with cultured individuals, there may be potential to substantially increase sales without overexploiting the wild stocks. Amongst the genera identified in southern Cameroon, several are of particular interest to the ornamental fish trade, including *Amphilius, Aphyosemion, Barbus, Benitochromis, Brienomyrus, Brycinus, Chiloglanis, Doumea, Epiplatys, Isichthys, Kribia, Mastecembelus, Microctenopoma, Microsynodontis, Nanaethiops, Neolebias, Paramormyrops, Parauchenoglanis, Pelvicachromis* and *Procatopus*.

WorldFish-OPED intervention

WorldFish and OPED began their direct intervention in forest river fisheries through a needs assessment. In each river basin, local fishers were identified and contacted through a series of field trips. The principal fishing villages in the area are Bidou on the Mpolongué River, Bissiang on the Kienké River, Ebomé in the Lobé River watershed and Makouré on the Lokoundje River.

Table 16-1. Fish species in eight low-order streams of southwestern Cameroon

	River (stream order)								
	Moliwe (2)	Koke/ Ekona (1)	Limbe (2)	Mana (1)	Iriba Inene (2.5)	Okoto (2)	Rengo (1)	Rengo (2.5)	Akpasang (1)
Aphyosemion 'akpa-yafe'									8
Aphyosemion splendopleure	15								
Aphyosemion bivittatum				4	2		37	5	5
Awaous lateristriga			2						
Barbus batesii	3			8	38		1		
Barbus callipterus	48			63	39		181	27	17
Barbus camptacanthus	15	75		71	2	175	73	20	26
Barbus trispilomimus	52	11							
Barbus progenys					38				
Benitochromis conjunctus				2			19	23	
Benitochromis nigrodorsalis	35								
Benitochromis ufermanni				20	92		2		20
Brienomyrus brachyistus				3	7		21	5	
Brycinnus longipinnus			21						
Chiloglanis disneyi		16							
Clarias camerounensis		5			8			4	8
Doumea thysi					8		5		24
Eleotris vittata			8						
Epiplatys sexfasciatus	2	182			180	268	143	28	45
Hemichromis elongatus			97						
Labeo batesii					30		5	8	
Malapterurus electricus					3				
Mastecembelus spp.					3		3	3	8

Oreochromis niloticus	2								
Parauchenoglanis spp.						24			
Procatopus KORUP				230	87	225	40	17	
Procatopus similis	37	57							
Pelvicachromis taeniatus	5								
Sarotherodon melanotheron			5						
Tilapia guineensis	1			2	10				
Varicorhinus spp.				3	51				5
Number of species						5			
Shannon Index	1.504	0.769	0.704	1.258	1.057	1.247	1.324	1.523	1.362

Typically, in each village one or two people organize the fishing and serve as the contact point for buyers. The majority of the actual fishers are children between the ages of nine and 14, who receive compensation in the form of food, shelter, school fees and health care. At any given time, there are about 25 children fishing in the four main villages. In the target area as a whole, 63 villages with a total population of approximately 7,200 are involved in, or affected to some degree by, ornamental fishing.

The bulk of the fish caught come from low-order streams, which can be easily waded and fished with hand-held nets manufactured from locally available fine-mesh netting secured to a metal frame. These are scooped or pushed into marginal vegetation, structure or other likely hiding places along the watercourse and lifted to capture the fish.

Reducing mortality rates during holding, local transport and shipping is one objective of the WorldFish-OPED programme. Training courses in gentle fish handling, transport and holding were developed and led by the fishers themselves with guidance from OPED, a Fulbright scholar and the WorldFish senior scientist (Figure 16-2).

Figure 16-2. Discussing management options. Experiential learning may be more practical than formal coursework in developing workable management plans.

In addition, students from the University of Dschang developed a fish food suitable as a dietary supplement during holding.

With the help of a revolving loan scheme set up and managed by OPED, some facility construction equipment (PVC pipes and nylon netting) was made available to the fishers. OPED technicians and the Fulbright scholar developed a training module and supervised pond construction. Such holding stations were thus constructed in each river basin, relatively close to the fishers to avoid long transport times and ensure the preservation of genetic variability amongst natural populations, which is highly appreciated by aquarium enthusiasts. In all, nine such holding stations with a total of 24 ponds have been constructed.

To ensure the preservation of the forest and the natural colors and comportment of the fishes, ponds were small and constructed in such a way as to avoid cutting trees (Figure 16-3 a, b).

(a)

(b)

Figure 16-3. (a) Simple modification of streams with natural materials to improve habitat for ornamental fishes. (b) Excavating small ponds in the forest to hold and reproduce fishes.

By simply modifying natural stream courses with small weirs, diversions and the deepening of certain sections, adequate space was made available for the installation of holding *hapas.* Fish are fed a maintenance diet manufactured from locally available agricultural byproducts. This improved their quality and survivability during transport (Lim et al. 2003) and allowed the fishers to maintain the fish in good condition for many weeks. Fish were also stocked outside the *hapas* to allow them to reproduce naturally. Along with the deepening of the streams and the feeding, which increased the fertility of the water, this had the effect of increasing the biomass of fishes living in the stream sections adjacent to the holding facility.

Discussion of the causes of mortality had led to much dispute over when and why the deaths were occurring. The fishers blamed the buyer and vice versa. To resolve the argument and explore the causes of the low survival rates, a recording system was devised that helped fishers keep track of the number of fish stocked and the number that died each day. The system made it abundantly clear that poor handling by the fishers was the main cause and opened the fishers' minds to the need for improved fish handling practices at their end of the value chain.

In addition to the holding stations in each river basin, a project office was established at the Centre Multipartenaire pour la Conservation et le Développement in Kribi where aquaria and holding tanks with aeration were installed to serve as a staging center for holding and packaging the fish prior to shipment.

The impact of the technological interventions on ease of collection and fish survival during transport was remarkable. Instead of being obliged to fish intensively upon receiving an order and then holding fish for weeks in plastic bags or buckets while the required numbers were being collected, fishers are now able to work when the water is low and easy to fish. When the buyer arrives to place an order, instead of waiting or having to come back to collect the fish), he now simply purchases the desired number of each species from the hapas and goes on his way. The combination of these effects has raised fish survival during shipment from an average of 20 percent to more than 90 percent.

Common initiatives and public-private partnerships

One of the initial motivations for OPED's interest in ornamental fishes was to address the problem of low prices by helping the fishers organize themselves into collective bargaining units. Although from different areas and ethnicities, with patience and external assistance, 10 fishers representing six villages finally came together and the Group Commune d'Initiative Aquariophile (GICA) was legalized in late 2006. Members no longer take orders directly from buyers. Rather, GICA serves as a coordinator, negotiating all orders according to a pricing schedule agreed upon by the members (Table 16-2). In addition to organizing the sale of fish, GICA also established a community development fund that channels 15 percent of each transaction into village projects, such as schools and clinics, although to date these have not been realized.

The profits from new orders rose dramatically through this process, but the upwardly revised prices discouraged many buyers. In addition, following the 2006 peace accords in the Democratic Republic of Congo, the largest exporter (approximately 20,000 fish per month) moved his base of operations from Douala to Lubumbashi. This and other changes in the local ornamental fish exporting business (see below) depressed orders.

It was originally imagined that GICA would be able to take overseas orders and organize its own shipments, further increasing their profits.

Table 16-2. Prices paid to fishers before and after creation of GICA in Kribi (CFA Franc 500 = $1.00)

Species	***Old price (FCFA)***	***New price (FCFA)***
Epiplatys sexfasciatus	25	125
Procatopus nototaenia	40	100
Neolebias ansorgei	40	100
Pelvicachromis taeniatus	100	400
(Chrom)aphyosemion	25	125

As the number of orders from the existing buyers declined, OPED sought to build within GICA the skills that members needed to take over the business themselves. Unfortunately, orders from overseas normally require more species than those available in the Kribi area, and without the contacts to collect these, it became clear that another arrangement would have to be made.

In early discussions with buyers and other local stakeholders concerning the management of the ornamental fish business, a young entrepreneur working on his own to collect fish was identified as a possible partner. This person's excellent knowledge of the rivers and ornamental fishes of southern Cameroon provided access to the other main fishing areas, and his understanding of governmental regulations proved invaluable in facilitating the shipment of fish overseas. In 2006, Gulf Aquatics was registered as a legal commercial entity in Cameroon and negotiated a public-private partnership arrangement with GICA that helps members access the international market and pays to the fishers 60 percent of the net profit received, equal to about 13 percent of the wholesale price—up from less than 5 percent previously.

Business planning

Because of the low survival rates, Cameroonian exporters had a very poor reputation in the international trade, and finding importers willing to work with the project proved more difficult than anticipated. In addition, wholesale prices paid by foreign importers are not in the common domain and initially had to be guessed at. When the fishers insisted on maximizing their revenues and named inflated prices, several possible deals were canceled.

By establishing personal contacts with one of the more reliable collectors and exporters in the region and through professional contacts with aquariophiles in Europe, more orders were eventually negotiated. In late 2007, Gulf Aquatics, through which orders are placed and handled, and GICA were exporting an average of 10 boxes per month. A calculation of the profitability of an exclusively export-oriented business plan, based on the experience to date, shows that a minimum of about three shipments per month of at least 10 boxes per shipment is required (Table 16-3). Although current exporters know that the profits to be made from exporting fishes are less than expected, these calculations, the first to be done in a systematic manner, permit planning.

Rather than rely exclusively on exports, several local entrepreneurs are attempting to develop local markets for aquarium species. Many of the shops that cut and sell glass, for example, also build aquaria. Of the three

Table 16-3. Enterprise budgets for two export ornamental fish business scenarios

Scenario 1: One shipment of 10 boxes per month (current arrangement)					
	Amount	***Unit cost***	***Total***	***Amortization***	***Annual cost***
Holding facility (120 m^2)					
Rent	1	$5,000.00	$5,000.00	10	$500.00
Tanks	25	$100.00	$2,500.00	5	$500.00
Aquaria	50	$50.00	$2,500.00	3	$833.33
Aeration	10	$320.00	$3,200.00	3	$1,066.67
Electricity (kw)	5000	$0.15	$750.00		$30.00
Water	1000	$0.80	$800.00		$800.00
Equipment	1	$1,000.00	$1,000.00	2	$500.00
Feeds	50	$60.00	$3,000.00		$3,000.00
Subtotal			$18,750.00		$7,230.00
Shipping					
Boxes	150	$1.00			$150.00
Bags, elastic	600	$0.50			$300.00
Chemicals	1	$100.00			$100.00
Taxes, fees	12	$200.00			$2,400.00
Collecting trips	12	$1,200			$14,400.00
Fish	12	$300			$3,600.00
Labour (person months)	36	$150			$5,400.00
Subtotal					$26,350.00
Revenues	12	$1,500			$18,000.00
			Net (w/holding facility)		-$8,380.00
			Net (w/o holding facility)		-$8,350.00

Scenario 2: One shipment of 10 boxes per week (proposed arrangement)					
	Amount	**Unit cost**	**Total**	**Amortization**	**Annual cost**
Holding facility (120 m^2)					
Rent	1	$5,000.00	$5,000.00	10	$500.00
Tanks	25	$100.00	$2,500.00	5	$500.00
Aquaria	50	$50.00	$2,500.00	3	$833.33
Aeration	10	$320.00	$3,200.00	3	$1,066.67
Electricity (kw)	5000	$0.15	$750.00		$30.00
Water	1000	$0.80	$800.00		$800.00
Equipment	1	$1,000.00	$1,000.00	2	$500.00
Feeds	50	$60.00	$3,000.00		$3,000.00
Subtotal			$18,750.00		$7,230.00
Shipping					
Boxes	550	$1.00			$550.00
Bags, elastic	3000	$0.50			$1,500.00
Chemicals	4	$100.00			$400.00
Taxes, fees	52	$200.00			$10,400.00
Air freight					
Collecting trips	6	$1,200			$7,200.00
Fish	52	$300			$15,600.00
Labour (person months)	36	$150			$5,400.00
Subtotal					$41,050.00
Revenues	52	$1,500			$78,000.00
			Net (w/holding facility)		$29,720.00
				ROI	0.50

ornamental fish retail outlets in Cameroon, one is a joint venture between Gulf Aquatics and a local partner. The advantage of the local market is that profit margins will be higher margins and shipping costs can be significantly reduced. Most Cameroonian aquarium owners, however, have traditionally preferred the brightly colored platys and swordtails, goldfish, angelfish and tiger barbs that dominate the global home aquarium market, rather than native ornamental fish (Livengood and Chapman 2007).

Although no statistics are available on the number of Cameroonian households keeping aquarium fishes, anecdotal evidence suggests that the popularity of ornamental fishes is on the rise. Aquarium displays at the annual Cameroonian trade fair attract numerous enquiries, and aquariums are appearing in increasing numbers in restaurants and doctors' offices. The University of Dschang has inaugurated a course in aquariology.

WorldFish has been active in supporting the development of the local aquarium fish market, for two reasons. First, there appear to be significant opportunities for increased investment throughout the value chain (Figure 16-4). A small business producing feed for ornamental fishes was supported by the WorldFish Center. A flyer explaining the care in captivity of indigenous ornamentals was produced, and expositions of local fishes are intended to make the public aware that they need not look overseas for pretty fish to put in their tanks.

The second reason for encouraging the display of local fishes is that, unlike in most of Europe or North America, virtually all of the exotic

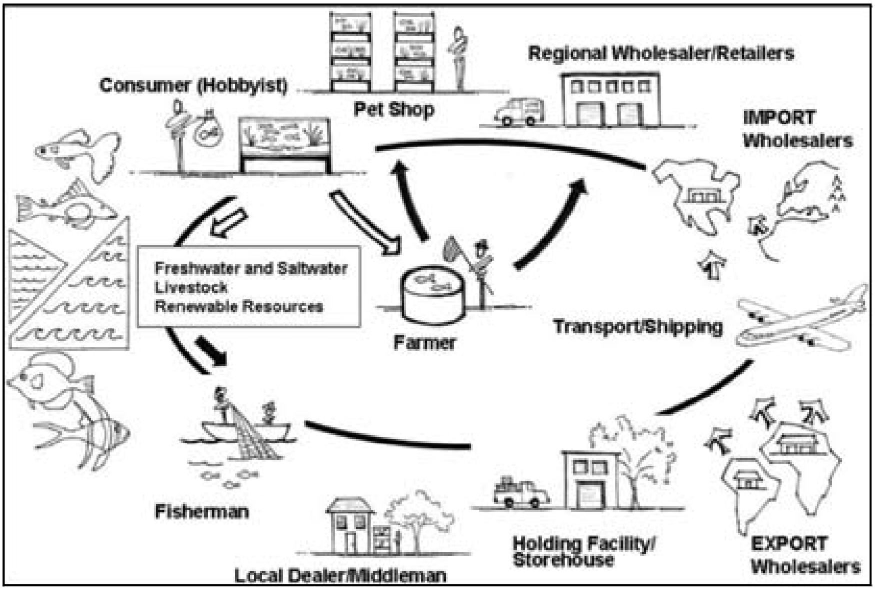

Figure 16-4. The ornamental fish value chain (from: Livengood and Chapman 2007)

fishes imported for home aquaria in Cameroon will survive in the wild and could pose a threat to indigenous biodiversity. Feral populations of swordtails and guppies have already established.

Sustainable management

Despite traditional management systems that regulate access and destructive land-use practices, overexploitation, particularly in women's traditional fisheries, has become a growing problem in the Kribi area as the human population puts increasing pressure on resources.

Catch per unit of effort (CPUE) is a major indicator of fishing sustainability (Welcomme 2001; Jul-Larsen *et al.* 2003). Each holding station now has a self-monitoring system whereby the fishers record the number by species of all fish captured per fishing day and stocked into ponds and/or *hapas.* This recording system not only permits the fishers to know exactly how many fish they have on hand at any one time, but also enables the calculation of CPUE and the analysis of trends.

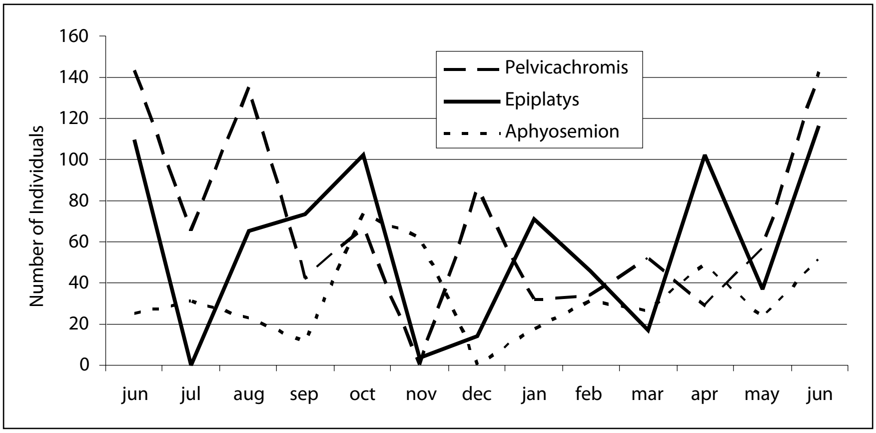

Figure 16-5. Catch per unit of effort of main ornamental fish species marketed from the Kribi area of southern Cameroon

Because of the large amounts of debris and associated refugia in these streams, the capture technique employed by fishers in the Kribi area appears to have little effect on overall fish density. Long-term data on fish harvests for the three most important species in the area indicate seasonal variation between rainy (difficult fishing) and dry periods (easier fishing) but no obvious trends in CPUE, indicating that the fishery is currently sustainable (Figure 16-5).

Not only is the GICA ornamental fish business sustainable in and of itself, GICA members represent a vocal advocacy group for the wise use of forest resources. GICA fishers are particularly active in the fight against the use of pesticides, which they perceive as a direct threat to their business. In addition, some non-GICA fishers still operate in the area and are reportedly still selling poor-quality fish at low prices, undercutting GICA's efforts to improve the sustainability and profitability of the fishery. The government of Cameroon has offered to arrest and prosecute these people (although there is no legal framework under which this might happen), but GICA declined to get involved and instead is attempting to enroll these fishers by tempting them with increased incomes.

Empowering the voices arguing in favor of sustainable use of the natural resource has been a major contributor to increased local interest in conservation of rainforest rivers. Posters have been distributed, local leaders have been informed, and an aquarium was installed by GICA in one of the most frequented hotels in Kribi. Prior to the project, most people did not know that there were beautiful and valuable fishes in their rivers. That has changed.

Lessons for the future

Whether increasing the awareness of ornamental fishes and the profits to be gained by capturing them will be ultimately good or bad for the resource depends to a large extent on the ability of GICA to evolve and of the GICA model to be more widely adopted.

Although most buyers continue to take advantage of the low prices charged by unorganized fishers, the lack of organization means that they have to pay high costs to collect the fish. In Kribi, a buyer can go to GICA, place an order and then visit the holding facilities to collect healthy fish. A buyer from Douala (two hours by road from Kribi) can make the trip in two days, with one overnight in Kribi. In contrast, a trip to Mamfé or Akonolinga usually takes more than a week, and the fish arrive in Douala stressed and in very poor condition.

Associated with this problem, as well as the high cost of local ground transportation, is the need for adequate holding facilities at the staging site. By increasing the number of fish that can be held, the number of collecting expeditions per year can be significantly reduced (Table 16-3). If the fishers throughout southern Cameroon can be organized in a way similar to those in Kribi, substantial savings would accrue to collectors and exporters, the fish would arrive at market in good condition, and more profits would be had by all.

For certain of the more widely distributed species, the organization of fishers in the Kribi areas has led to increasing levels of exploitation at other collecting sites. A number of contracts have been lost to Nigerians and less scrupulous Cameroonian exporters who, when confronted with higher prices, have shifted their orders to other fishers.

Many individuals of the most important species emanating from the Kribi area are no longer captured exclusively from the wild but are reproduced and grown in the quasi-natural collecting stations. As this transition from capture to culture goes forward, gains in sustainability and profits might be predicted (Pomeroy et al. 2006). Investors with more capital and experience would have a clear advantage over the villagers in commercial aquaculture of ornamental fishes and could easily take over the trade. Although this would theoretically reduce pressure on the natural resource, many low-income villagers would suffer reduced incomes, and if aquaculture completely replaces the capture fishery, one could anticipate reduced interest by the fishers in protecting the resource (Tlusty 2002). It would be wise for development and natural resource management planners to consider this important aspect, which most likely applies to a broad range of nontimber forest products that are currently being developed in culture to replace the wild harvest. Those who depend upon sustainable exploitation of natural resources, if they can make enough money to become truly empowered, have a strong hand in decision making at the village level and are a far more credible voice for conservation than any foreigner.

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