USEFUL DISASTERS: THE COMPLEXITY OF RESPONSE TO STRESS IN A TROPICAL LAKE ECOSYSTEM

Marion Pratt
American Association for the Advancement of Science

Abstract: The introduction of the Nile perch in the 1960s enhanced the economic value of the local fishery and encouraged women to become involved in fish processing and marketing. Over time, however, the predatory perch has severely reduced stocks of popular indigenous fishes. Currently, competition created by high foreign demand for the perch is forcing small-scale traders out of business and depriving local consumers of fish protein. Case studies reveal that the increased competition also has elicited various forms of production relations among men and women processors and traders. The complexities associated with the socio-ecology of this ecosystem hinder attempts to develop effective management policies.

Résumé: Dans les années soixantes, le fait d'avoir introduit la perche du Nile a rehaussé la valeur économique de la pêcherie locale et a encouragé les femmes à participer plus dans le traitement des poissons et dans le marketing. Toutefois, avec le temps, la perche, poisson prédateur, a considérablement réduit la quantité de poissons domestiques qui étaient prisés. Actuellement, la compétition créée par une forte demande étrangère pour la perche oblige les petits commerçants à fermer boutique, privant ainsi les consommateurs locaux d'une importante source de protéine de poisson. Des études de cas ont montré que l'augmentation de la compétition a aussi provoqué diverses relations entre les hommes et les femmes qui traitent le poisson et les commerçants. La complexité associée à la socio-écologie de cet écosystème empêche les tentatives de développement de bonnes politiques de gestion.

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Introduction

The introduction of the Nile perch (*Lates niloticus*) into Lake Victoria in the middle of this century has had far-reaching repercussions. To examine this phenomenon adequately requires a powerful analytical framework that combines both historical and processual ecological methods. Historical ecology as outlined by Schmidt (1994) seeks to identify ecological transformations induced by human cultural systems over time by analyzing the interplay of cultural systems with the physical environment. Processual ecological methods also serve to identify various mechanisms that link environment and behaviour by employing small and large units of analysis, dropping assumptions of equilibrium and balance and addressing processes of conflict and co-operation (Orlove 1980). Processual ecological anthropology examines the "interactions between the choices which actors make, behaviours on an individual or group level, and the biological and social systems which influence the distribution of resources, constrain the possible adaptive strategies and provide some of the goals which the actors attempt to meet" (Orlove 1980:257).

This article investigates a few of the complex relationships between the Lake Victoria ecosystem and the human populations that depend on its resources. It suggests that the development of useful resource management policies becomes problematic when the very patterns and dynamics of resource production and distribution are constantly undergoing changes that are incompletely understood and relatively unpredictable.

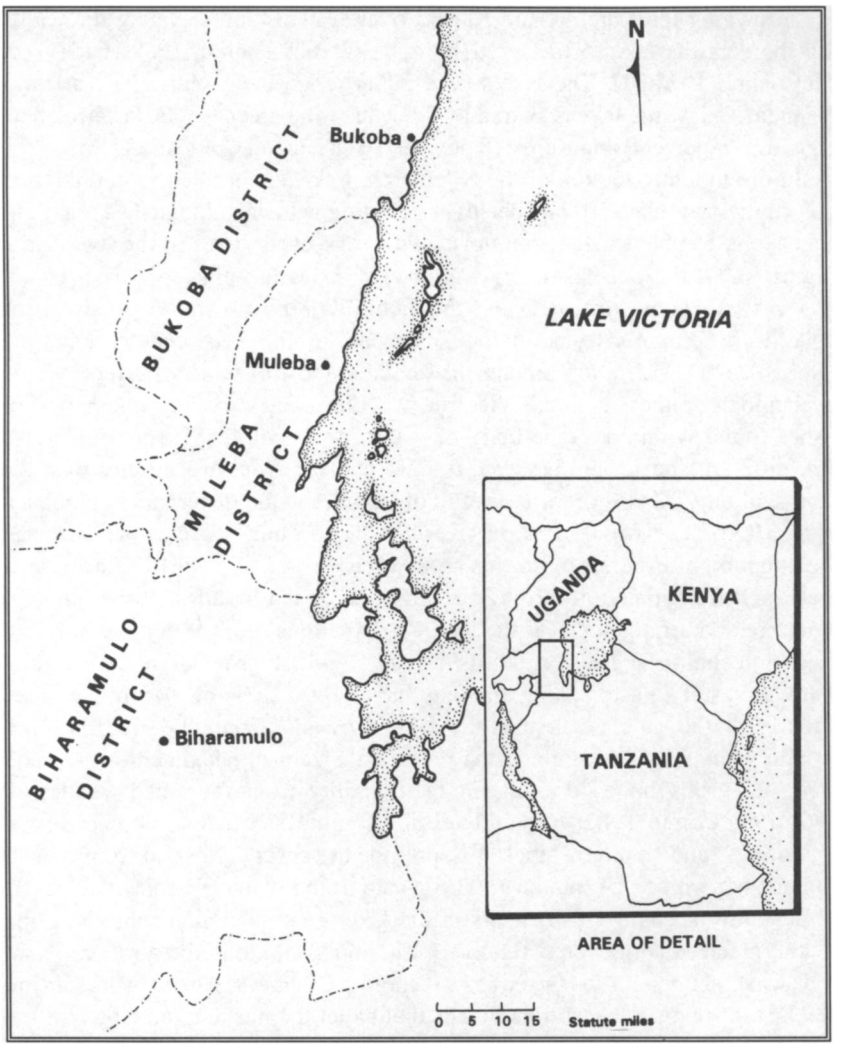
The Setting: Lake Victoria and Its Western Shore

Located mostly in the Kagera Region of Tanzania, the western shore of Lake Victoria consists of three main agro-ecological zones: a well-watered area stretching along the shore from Muleba and Biharamulo Districts north to the border with Uganda; a drier, flatter area located in Biharamulo District to the south; and a high plateau that stretches west toward the Ruwenzori mountains (see Figure 1). Seasonally heavy rainfall in the northwestern portion of the region has leached the soils of their nutrients over the millennia. Local farmers responded by painstakingly building up the land, using mulching techniques to nourish their plantations of plantains and coffee. The poor quality of the soil has also obliged many local women to look to off-farm activities for personal income generation.

The western shore is inhabited by Haya peoples in the north and Zinza—mixed with other groups—in the south. In pre-colonial and colonial times, the highly stratified, patriarchal Haya and Zinza societies were ruled by kings who maintained their control through a feudal, agropastoral system based on plantains and cattle. European colonization of East Africa at the turn of this century greatly diminished the power of these kings. The introduction of animal and human diseases, Western religions, new fish species and the cultivation of

coffee for export during the German and British rule strongly influenced the social and physical environments of the west lake region.

Figure 1
The Western Shore of Lake Victoria



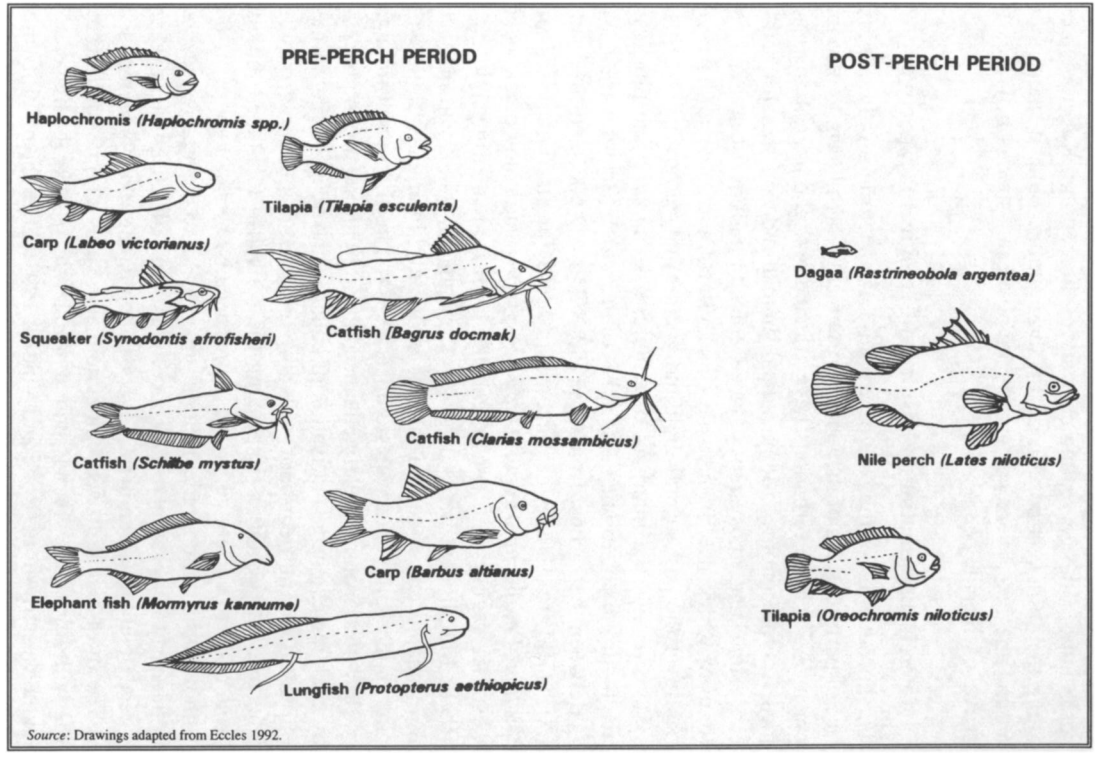
Perched on a plateau about 1128 metres above the Indian Ocean, Lake Victoria is the largest tropical lake in the world, approximately the same size as Ireland [between 26 200 and 26 828 square kilometres (EAHC 1953; Ford 1955)]. The lake shoreline, including dozens of islands, is about 4800 km long

(Graham 1929:53). With a maximum depth of 79 metres, Lake Victoria is the shallowest of the great Rift Valley lakes and thus the most potentially productive due to the annual overturn of its waters that circulates nutrient salts from the lower levels of the lake. Lake Victoria was created about 750 000 years ago by post-Miocene tectonic movements which formed the East African Rift Valley, drowning the Katonga and Kagera river systems and elevating the region that borders the lake to the west (Fryer 1972:462; Kendall 1969:164; Lowe-McConnell 1975:37). The lake's only outlet is via the Victoria Nile at Jinja, Uganda. Today, the lake is shared by Tanzania (48 percent of the surface area), Uganda (44 percent) and Kenya (8 percent) (Butcher and Colaris 1975:1).

Before the introduction of the Nile perch, Lake Victoria harboured the second highest number of fish species—including catfishes, lungfishes, cichlids, squeakers, elephant fishes, minnows and carp—of all lakes in the world (see Figure 2). Of these fishes, a large number of haplochromine species, the minnow *Rastrineobola argentea* and the cichlid *Tilapia esculenta* provided the bulk of fishermen's catch in the latter part of the 19th century (Swayne 1868:102). The variation among the cichlids, most of which are represented by haplochromines, in Lake Victoria was the greatest of any one group of fishes found within a single body of water in the world (Wilson 1992:108); 300 different species are believed to have evolved from one species over the course of only 12 000 years as a result of environmental disturbances (Johnson et al. 1996). The wide variation among haplochromine species has attracted the attention of fisheries biologists around the world (Ligtvoet 1989). The species are differentiated according to the shape of the mouth and the number, structure and arrangement of the teeth—adaptations to a variety of foods and feeding techniques. These small fishes, few of which grow larger than 15 cm, were harvested in astonishing amounts (up to 1800 kg/hour) before the introduction of the Nile perch into the lake (Lowe-McConnell 1975:134). Although some researchers claim that the small size of the haplochromines and their numerous bones diminished their quality as a food fish (Anderson 1961:196; Comte 1982; Reynolds et al. 1995), Haya people appreciate the "vitamins" and "protein" these fish provide as especially useful for pregnant and nursing women (Appleton 1993:62; data from my interviews with elders).

Generally speaking, fish stocks in the lake were most abundant along the southern and eastern shores, relatively less abundant along the northern shore and least abundant on the western shore (Graham 1929:116; Kollmann 1899:6). Strong southeast trade winds that batter the unsheltered length of the western shoreline for most of the year (Ford 1955:3; Graham 1929:63) hinder the west lake fishery by compromising the manoeuvrability of fishing, trading and transport vessels and by creating a coastline blanketed with wave-washed sand rather than the accumulated mud that is common along all other shores of the lake (Culwick and Culwick 1940:80; Ford 1955:40; Lowe-McConnell

Figure 2
Fish Species Abundant in Lake Victoria Before and After the Introduction of the Nile Perch



Source: Drawings adapted from Eccles 1992.

1975:127). Large populations of *Tilapia esculenta*, the most important food and trade fish of Lake Victoria in the pre-perch period, were found only in places sheltered enough to permit mud to accumulate (Graham 1929:117). Partly because low stocks of this important commercial species limited the scale and income-generating capacity of the northern Kagera fishery, women along the northwest portion of the shore, unlike other women in other areas around the lake, were not greatly involved in fisheries activities before the arrival of the Nile perch.

The Perch Introduction in Historical Ecological Perspective

The introduction of the Nile perch into Lake Victoria is only one in a long series of perturbations of the local environment which I term "episodic catastrophism." These perturbations have affected both the natural environment and local socio-economy. Many radical, human-induced transformations of the ecosystem and ecosystem-induced transformations of human populations (both of which may be considered socio-ecological events) have taken place here over the past several thousand years. Analyzed over time, this feedback system reveals the interplay of cultural systems with the physical environment—or the "historical ecology"—of the region (Schmidt 1994:100).

Between the earliest Iron Age (200 BC to AD 600) and the Late Iron Age (AD 1700 to 1900), the once vast, dense forests (comprised of *Miscanthidium*, *Entandrophragma*, *Uapaca*, *Syzgium* and many other species) in the west lake region were cut to feed the local iron-smelting industry (Schmidt 1994). Magnificent herds of gazelles, elephants, rhinos and other wild game were hunted out or chased into the shrinking hinterlands to the west. Beginning in the 13th century, pastoralists from the north brought in huge herds of cattle whose manure greatly enhanced the agricultural productivity of the area by enabling extensive cultivation of bananas and beans. Local farmers further improved the nutrient-poor soils through careful mulching, building up the land over the centuries. Improving the soils also facilitated the commercial production of coffee, which was introduced by German and British colonists. Although the coffee trade brought great wealth to the area for several decades in the early 20th century, the concomitant long-distance trade exacerbated the spread of smallpox, cholera, jiggers, bubonic plague and venereal diseases.

The most recent disease epidemic may be a by-product of Tanzania's 1978 war with Idi Amin, which is said to have left in its wake the first cases of AIDS on the western shore (Bond and Vincent 1991:120). The mobility of fishermen and fish traders place them among the groups at high risk of catching the disease. The economic and social costs of AIDS in this region are astronomically high and rising, "draining away the development impact of any increased production" (Appleton 1993:64). The banana plantations and local soil enhancement techniques are being seriously neglected due to reductions in the agricul-

tural labour force from disease and outmigration. The perch trade as well has drawn farmers away from their lands to catch fish.

The Ecological Impacts and Implications of the Nile Perch Introduction

An Overview of Exotic Species Introductions

The structure and function of ecosystems are sustained by synergistic feedback processes between organisms and the environments which they inhabit. The capacity of an ecosystem to respond to imposed stresses or shocks depends in part on the maintenance of a minimum level of biodiversity within that ecosystem. "All self-organizing living systems," claim Perrings et al., "require a minimum diversity of species to capture the sun's energy and to develop the cyclic relations of fundamental compounds between producers, consumers, and decomposters" (Perrings et al. 1992:202). While we do not yet know the threshold of diversity beyond which an ecosystem cannot function, it has long been suspected that the earth cannot sustain the current loss of species without undergoing significant negative effects on its biological health and productivity.

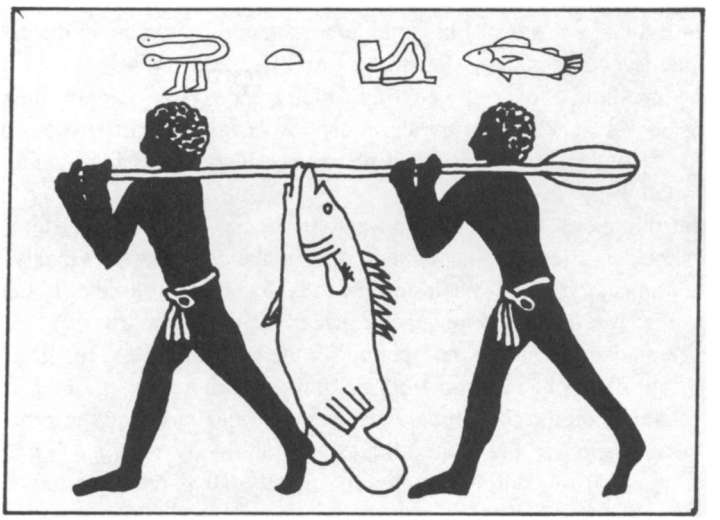
The introduction of exotic, or non-native, species into an ecosystem represents a shock or stress to that system, an imbalance in the previously established relations among the species indigenous to that environment. In many instances, introduced species negatively affect their new environments by outnumbering native species, by competing for their food or spawning grounds or through hybridization (Twongo 1995). A few well-known cases of harmful introductions include the sea lamprey (*Petromyzon marinus*) and the zebra mussel (*Dreissena spp.*) in the United States and rabbits (*Oryctolagus cuniculus*) in Australia. Wilson claims that approximately 20 percent of the world's freshwater fish species are either extinct or in serious decline as a combined result of overfishing and the introduction of exotic fish species (1992:256). On the other hand, recent field work in Northeast Thailand, California and Australia demonstrates that some native species have been able to maintain healthy populations despite their interactions with non-native species. In some instances, the introduced species have even enhanced the economic value of their new aquatic ecosystems (De Iongh and Van Zon 1993; Hall and Tonbridge 1988; Vondracek et al. 1989). The case of the Nile perch in Lake Victoria appears to fall somewhere in between.

The Nile Perch in the Lake Victoria Ecosystem

Found in many major river systems in Africa, *Lates niloticus* is the largest freshwater fish in Africa and the largest freshwater percoid, or spiny-finned fish, in the world (Gudger 1947). In ancient Egypt, the perch was highly valued; numerous mummified remains and paintings on the walls of tombs attest to its importance

for the peoples of the Nile (Gudger 1947) (see Figure 3). In fact, several species of *Lates* inhabited the Victoria basin in the distant past, as evidenced by fossils found on Rusinga Island in Miocene deposits (Fryer 1960; Lowe-McConnell 1975:37). Thus it has been argued that the Nile perch could actually be considered a *reintroduced* rather than an exotic species (Fryer 1960:267). The perch probably died out with the disappearance of open stretches of well-oxygenated water during the course of the Rift Valley development (Fryer 1972:461; Johnson et al. 1996), while other fishes such as the cichlids evolved.

Figure 3
Depiction of the Nile Perch from the Grave of Medum Rahotep



Source: Adapted from Petrie 1892:Plate XII, south wall and south side of recess stele.

In the late 1920s, colonial fisheries personnel began to voice their worry that the stocks of endemic tilapias and several anadromous species were being overfished (Acere 1988; Graham 1929). Some proposed to introduce the predatory Nile perch or tiger fishes (*Hydrocyon spp.*) in order to convert the small haplochromines into a more valuable form of food (Graham 1929:22). From 1951-53, exotic tilapias (*T. zillii*, *T. rendalli*, *Oreochromis niloticus* and *O. leucosticus*) were introduced to increase the numbers of food fishes (Acere 1988; Lowe-McConnell 1975:136) and, in the 1960s, the Nile perch was introduced to the lake in Ugandan waters (Anderson 1961:200).

The perch spread throughout the lake in a clockwise direction, preying upon the abundant stocks of haplochromines. By 1987, haplochromines represented only .9 percent of the total catch in the lake, down from 35 percent in 1981

(Bwathondi 1989:26). By 1988, there were no significant commercial catches of haplochromines at all in Tanzanian waters (Bowman 1990:4), while the perch comprised 65 percent of the catch (CIFA 1992:2).

Current transformations in the Lake Victoria ecosystem have resulted from more than just the impact of introduced fish species. Severe overexploitation of fish stocks remains a serious problem. The spread of the water hyacinth (*Eichornia crassipes*) and accelerated algal growth and eutrophication also compromise lacustrine productivity. Imported to East Africa from South America, the hyacinth can grow to cover 100 square metres in a few months (Chamberlain 1993:10). The plant reduces oxygenation at the water's surface by blocking sunlight and minimizing turbulence, restricts the passage of boats and hinders fishing activities. Studies are underway to determine practical and efficient means of eradicating the hyacinth.

Increasing eutrophication also threatens Lake Victoria waters, described in the last century as being "clear as crystal" (Kollmann 1899:5; Long 1876: 139). Noted, beginning in the late 1950s (Hecky 1992), were higher concentrations of algae which have resulted from the loss of cichlid species—both tilapias and haplochromines—that fed on algae and detritus (Graham 1929; Lowe-McConnell 1975:134). Also noted were increased runoff from farms and factories and phosphorous loading from deforestation (Chamberlain 1993; Richerson 1993:135).

The need to control human-induced runoff, manage the fishery and monitor the ecosystem of Lake Victoria has long been recognized by the three riparian state governments. Regional co-ordination began in 1947 with the establishment of the East African Freshwater Fisheries Research Organization (EAFFRO), but languished with its collapse in 1977. In 1980, a sub-committee of the Food and Agriculture Organization of the United Nations, the Committee for Inland Fisheries of Africa (CIFA), adopted some of those duties, and this past year a multilateral Lake Victoria Fisheries Commission was established to facilitate the co-ordination of research and management strategies for the Lake Victoria basin.

The Socio-economic Impacts and Implications of the Nile Perch Introduction

Initially, neither biologists nor local fishermen and consumers appreciated the perch. Many biologists were convinced that the perch's predation of indigenous populations, an example of the "pauperization" of an ecosystem through the loss of biological capital stock (Jutro 1993:248), would result in the most massive extinction of species in the history of humankind (Comte 1982; Wilson 1992). Some local consumers disliked the taste of the perch, and found the fish difficult to prepare and more expensive to process because of its high fat content. Furthermore, the perch was quite rightly blamed for destroying

valued species of local fish and for damaging fish nets (NSF 1992; Reynolds and Gréboval 1988). As the stocks of *Lates* continued to grow, however, their economic potential was eventually recognized, appreciated and heavily exploited. Total annual harvests from the lake rose from an estimated 100 000 tons (pre-Nile perch) to between 350 000 to 400 000 tons (CIFA 1989). These days, fishermen on the western shore are quick to acknowledge the role the perch has played in raising their incomes and standard of living, but many still prefer to eat the now rare lungfish and catfishes (Appleton 1993:90; Bean 1991:82).

The rapid growth of the fishery has spawned as many problems as opportunities. The lakewide demand for netting material has exceeded the supply and theft is such a problem (Bean 1991:5; Ligtvoet 1989:152; Reynolds and Gréboval 1988:31) that fishermen are now obliged to stay out on the water at night, remaining in their canoes in the damp and cold to watch over their nets instead of returning in the morning to bring up their catch. Fishermen are migrating from the areas where the perch have been overfished, along the eastern perimeter of the lake, to catch the fish in its last strongholds in southern and western waters (Bean 1991:57). Labourers appear to be shifting from local farming and livestock activities into the perch business (Appleton 1993:52; Hoekstra 1992:xi), with as-yet-unknown effects on agricultural production. The combined impacts of new fishing technologies and large-scale export of the perch to Europe, Israel and the United States have increasingly stratified the fishing population, which in many areas is now dominated by wealthy businessmen (known locally as "fisher kings"), transport truck owners and large-scale processors (Asowa-Okwe 1992; Harris et al. 1995). As the demand for and price of the perch have risen, fewer consumers on the western shore are still able to afford to buy fish as a regular source of protein.

The Effects on the Fish Trade

Before *Lates* dominated the fish trade around the lake, most fish was consumed where it was caught, or sold fresh along the coast (EAHC 1953:3). Endemic tilapias, however, were exported in large quantities to Nairobi (Dobbs 1928:107; Ford 1955:62). Dried fish was transported from the islands and sold in Uganda where traders could obtain better prices (Césard 1935; Hartwig 1976:84; Mors 1953:91; Reining 1967:175). Some of the fish traders also bought and sold coffee (Culwick and Culwick 1940:83), another example of linkage between the fishing and agricultural sectors.

Starting in the 1980s, vast increases in Nile perch harvests shifted the supply-demand balance. Currently, perch are being exported from Kagera waters to meet the high demand in other countries. An estimated one third of the total catch now goes to Burundi, Rwanda and Zaire (Bowman 1990:11), some of which feeds refugee populations. In a new trade arrangement, joint-venture exporters from Kenya buy fresh perch directly from fishermen or middlemen

and transport it by refrigerated truck from Bukoba and Kemondo Bay (a landing site where fish are brought in from the islands) to Uganda. Eventually the perch is shipped overseas to generate desperately needed foreign exchange. The Kenyan company that constructed a filleting plant in Bukoba employs far fewer local workers than had been originally promised and competes with local traders for fish, as evidenced in the case study below.

Case Study 1

Mama Sifa, who has ethnic ties to Rwanda, buys and smokes catfish and perch from a half-dozen markets in towns along the coast from Bukoba to Muleba. She received two loans from a U.N. regional integrated fisheries project, one of which she was able to repay ahead of schedule. Hired by others to sell fish from 1982 to 1984, she saved her pay and eventually started her own business. "No one even knows I got the loan," Sifa laughed. "I didn't want trouble, or for the money to be stolen. I didn't even tell my husband until my project was underway and doing well!" Their businesses are separate, and Sifa seems free to spend her money as she likes. "Although I have a lot of experience trading fish," Sifa admitted, "I really should move into the second-hand clothes business. Fish are hard to get now. The [Kenya-owned fish filleting] factory [in Bukoba] is buying all of them."

At the time of my most recent visit in 1996, foreign fish traders had collected such a large percentage of the catch for export that the price of fish was already well out of the reach of many locals. Although higher fish prices benefit fishermen, many consumers and small-scale processors, including virtually all women processors, are finding it very difficult to compete with the exporters.

As the Nile perch spread around the lake, fishermen, processors and traders responded quickly to the expanded opportunity in the fishery (Reynolds and Gréboval 1988). Fish can now be found throughout the year, even during the months between April and August, when fishing had been very slow in the pre-perch period (Dobbs 1928:99; EAHC 1953:5). The estimated number of fishermen on the lake increased 140 percent from the mid-1950s to the mid-1980s (Bwathondi 1989:24; EAHC 1953).

Bigger fish harvests from pre-industrialized nations around the world have filled a gap in the world market that has resulted from overfishing and insufficient yields in industrialized countries. While this has meant increased income for fishing communities in poor countries, the transformation of essentially subsistence or "for use" fisheries into primarily commercial or "for exchange" fisheries has had far-reaching negative effects as well. The survival of the few remaining healthy fish stocks is threatened by increased exploitation. There is now a steady flow of fish from poor countries, where they used to be the cheapest form of animal protein, to rich ones (Kent 1987). Facilitated access to more efficient technologies has encouraged individual rather than com-

munity organization (Lieber 1994), interest in short-term profits rather than long-term use (McCay 1978) and the erosion of common property control of fish resources (Bailey 1988).

The Gender Impacts and Implications of the Nile Perch Introduction

An Overview of Gender Roles in Fishing Societies Around the World

In only a handful of fishing societies around the world do women work side by side with men to catch fish. The dangerous, high-risk nature of fishing has fostered certain ritual beliefs that have served firstly to restrict women from access to boats and boat construction, secondly to keep women away from men engaged in fishing magic or preparing for a fishing trip (Acheson 1981:288), thirdly to encourage men and women to refrain from sexual intercourse before fishing and lastly to prevent menstruating or pregnant women from participating in communal fishing activities (Chapman 1987:882). Some fishermen claim that having women on board a vessel is disruptive (Allison and Jacobs 1989:164). But the most common reasons cited for women's limited participation in fishing activities are the following: (1) women's primary attention to time-consuming reproductive and domestic tasks reduces their opportunities for travel and availability; (2) cultural proscriptions inhibit the contact of women with unrelated men; and (3) that women's limited access to training and start-up capital restricts their ability to undertake income-generating activities (ALCOM 1992:10; Allison and Jacobs 1989; Hourihan 1986:86). In some places, low returns from fisheries activities discourage women's participation (Gulati 1981). However, women in fishing communities become eminently visible when the definition of a fishery is expanded, correctly, to include activities that are equally important to the success and efficiency of the fishery as a whole.

In addition to harvesting, all fisheries economies have two other crucial sectors: processing and marketing. Due to the high perishability of fish and fish products, all three sectors are inextricably interrelated and interdependent (ALCOM 1992:3). With the attention focussed on the hunt on the "high seas," other parts of the harvesting sector in which women are importantly involved until recently have been generally ignored. For instance, women make important contributions to their household economy by harvesting seaweed, seashells, bivalves, crustaceans, octopus and squid, and small fish on reefs and shoreline areas around the world (Chapman 1987; Cole 1991). An even greater number of women participate in various processing and marketing activities. Tied importantly to fish harvesting, processing and marketing, ancillary activities in which women often play a dominant role include net-making and mending, fuelwood collection, beer brewing, preparation of lodging and meals, and the provision of informal credit and sexual services (ALCOM 1992:13).

In a few extensively documented cases, most notably in coastal communities in West African countries, men and women fisherfolk work together very

closely as units of efficient, productive co-operation. In these instances, wives buy fish from their husbands to process and sell (Vercruijsse 1983). Sometimes these same women extend credit to fishermen from their savings. Female fishmongers in Ghana and Senegal, for example, have acquired considerable wealth and power through their marketing enterprises, although the specific ecological and historical reasons behind their empowerment have yet to be determined (Leacock 1986:122). Similarly, Mead found that some women among the Tchambuli in New Guinea had gained significant status through the trade of fish (Mead 1935), and Gulati observed the same among the women of Kerala, India (1981).

Where women are involved importantly in fisheries activities, they carry more responsibilities and power in the community and at home (Cole 1991; Thompson 1985:3). The primary responsibility of women in all fishing communities, to raise children and thus reproduce the fishing unit, is often overlooked and undervalued. In fishing economies where the fishermen stay out to sea for months at a time, women are relied upon heavily to keep the affairs at home in order.

In those communities where women customarily were involved in fisheries activities, the effects of modernization have often been negative. Modern gear has negated the need for net makers and menders (Hourihan 1986), middlemen with more money and better business contacts have displaced female traders (Pàlsson 1990; Robertson 1984), automated factories are doing the work of women gutters and scalers, and foreign business interests and local banks have edged out women as loan providers (Vercruijsse 1983). However, the development of a large exchange market for fish in places where women were previously not involved importantly in fisheries activities, such as in the northwestern corner of Tanzania, can provide windows of opportunity for women who judge the potential for income generation high enough to risk involvement in a low-status, male-dominated field.

Women's Changing Roles in the Western Shore Fishery

While women have long been involved in fisheries activities on the eastern shore of Lake Victoria (Dobbs 1928:99; Hoekstra 1992:x; Reynolds and Gréboval 1988:8), the participation of women along the western shore was extremely limited before the arrival of the Nile perch (Bowman 1990:8; UNDP 1991:13). Elders interviewed for this research from communities in both the northern and southern districts unanimously voiced the opinion that during the pre-perch period, very few women were involved in fish processing, marketing or capture. At most, women scaled, cleaned and cooked fish brought to the house. Several elders did recall, however, that a few "brave" women occasionally helped pull fish out of nets brought in to shore.

The reasons for women's limited participation included the absence of *tilapia* in the northwestern waters, the presence of steep cliffs along the lakeshore that hinder travel to and from fishing settlements, the threat of raiding

war parties from Uganda and the dangers posed by crocodiles and hippopotamus that inhabited the lakeshore until the middle of this century.

Local taboos and restrictions keeping women out of the fisheries sector mirrored real threats to the welfare of those working on or near the lake. In previous centuries and up until the arrival of the Germans into the area, Baganda chiefs from the area just north of Kagera Region regularly sent raiding parties up and down the coast, forcing many local inhabitants to settle well inland to avoid attack. At the turn of the century, the explorer Declé noted that, because of crocodiles, most local fishermen never learned to swim (Declé 1898:390). The reptiles could "overturn small fishing boats or seize the crews, and sometimes even attack people standing on the shore" (Peters 1891:490). Information gathered through household surveys, interviews with village elders and archival documents revealed that the elimination of inter-kingdom warfare and dangerous wild animals during the colonial period in combination with the new opportunities in the improved fishery encouraged the growing participation of local women in fish processing and marketing.

The arrival of the perch into Kagera waters changed markedly the gender division of labour in the fishery. "Since the arrival of the perch," stated one male informant, "many women are participating in fisheries activities." More women and girls are helping to pull in beach seines (although few will agree to work out on the open water). The growth of local women's participation in the fisheries economy along the western shore is due also to the decline of the local agricultural sector and to the debilitating effects of AIDS in the region. Like the woman interviewed in the following case study, many villagers are taking advantage of every opportunity to generate income to support ailing relatives or orphaned children.

Case Study 2

Mama Chausiku cares for her own child and two of her deceased sister's children in a grass house in a small fishing village in Muleba District. She is pregnant again, but still unmarried. "No one wants to get married to a woman who is already taking care of so many kids," she explained wryly. For a long time she smoked and fried fish, but the smoke from the fires has begun to irritate her lungs, a common affliction of fish processors. Chausiku is hard-working and self-reliant, paying back her fisheries project loan well before its due date. "I also sell cassava flour ground at a milling machine in Muleba. And I grow sweet potatoes, too. I make as much money from that as I do from my fish business! Other women who applied for loans and didn't get them said I'd never be able to pay back mine," she laughed.

These days, a growing number of women are involved in fish-processing activities (Kiobya 1994). Methods of processing fish in Kagera Region used in the pre-perch era, which include sun-drying, smoking, frying and salting, are

the same used today, although the intensity of the processing effort has increased. Because of the large amount of fat contained in Nile perch, more fuel is required to smoke them than to smoke any other species, resulting in higher processing costs and further exploitation of the local forest resources (Ligtvoet 1989:153; Reynolds and Gréboval 1988:ix). In the southern part of the region, juvenile perch are dried and smoked on piles of burning grass. Women processors, like the one described in the next case study, have found they can more easily afford to buy and sell small fish than large ones.

Case Study 3

Mama Jovenia, mother of two small children and the wife of a fisherman, trades smoked perch and tilapia in Biharamulo District. She also sells fried perch and ginger tea from a small shop. A competent businesswoman, she also applied for and received a loan from the U.N. fisheries project, which allowed her to expand and further diversify her activities. "I learned the fish business by watching my sister [who lives in a nearby village]," Jovenia explained. "I tried it myself and saw it was easy!" She buys dagaa [the minnow *Rastrineobola argentea*] and juvenile Nile perch from her husband and resells it, using the proceeds to buy soap. She then reinvests the profit from the sale of the soap in her fish business. "If I had more money, I would buy children's clothes, second-hand goods, and cloth to trade in Mwanza [the regional capital on the southern edge of the lake]," she added, gazing down at the pile of small fish at her feet. The juvenile perch her husband brought in for his wife this day are only four or five inches long, caught many growing months before reproductive maturity, when they could have spawned and replenished the local stocks.

The Nile perch is the only fish processed extensively through frying, which is undertaken almost exclusively by women. Gutted and dried, the fish are cut up into small sections, fried in large pans, and sold by the piece. The frying process generates so much fish oil that it is collected afterwards and sold as a by-product. Other perch by-products include the skin (used to manufacture shoes, belts and purses in some areas) and the swim bladder, which is stretched and sun-dried until hard and then sold to traders for export to the British Isles for filtering beer and wine and to the Orient for making soup stock (Baskin 1994:79). The Nile perch is caught in sufficient size and quantity to be frozen whole or as fillets and transported to urban centres (Kampala, Nairobi, and Mombasa in this case) for export to Europe, Israel and the United States.

Women are also involved in fish trading and support activities: running tea shops and providing domestic services for fishermen. A few even own boats and hire crews. Bereft of resources, many AIDS widows travel to the islands to provide sexual services (Appleton 1993:65,105). Fisherfolks' fear of contracting AIDS has encouraged the adoption of "hawala" or "wife-to-be" contracts in fishing communities, a type of long-term partnership between a man and

woman that promotes monogamous relationships (Appleton 1993:58). It is rare to find a woman surviving without the protection of a man, whether he be husband, boyfriend or relative, in the rowdy, somewhat lawless communities situated in the more remote areas of the region.

Women's Involvement in the Western Shore Fishery as Historical Process

Women's increased involvement in the male-dominated fishing industry on the western shore is the most recent example of a series of social and economic roles ascribed to or adopted by local women over the past centuries that transcended their customary roles as mothers and wives. Women in this area held the roles of princesses and priestesses in the royal courts, sisters in Western missions and sex workers in urban centres of East Africa. Therefore, it is hardly surprising that, once most of the dangers associated with the lake disappeared and the fishery became much more profitable due to the Nile perch trade, women grasped the opportunity to carve out a niche for themselves in this sector. However, the security of women's new opportunities in the fishery and the potential empowerment that would accompany their generation and control of income is seriously threatened today, because foreign traders are facilitating the transfer of protein capital from the western shore of Lake Victoria to Western nations that have already severely depleted their own fisheries resources. Gerrard observed the same phenomenon on the eastern side of the lake (1991). As evidenced by the case studies presented in this article, competition in the Lake Victoria fishery has also engendered various forms of inter- and intra-household conflict and co-operation.

The Future of the Western Shore Fishery

The relatively late arrival of the perch to the western shore in contrast to the other areas of the lake has meant that the fishing populations in this region have benefited significantly from the growth in the fishery only within the last decade or so. The new opportunity to make money, especially in light of recent low crop prices and production, has drawn more men and women to the lakeshore, and in the process transformed a once-despised occupation into the last hope for a physically and spiritually wounded people. Intensification of fishing effort has already made inroads into the perch population, however, as evidenced by the reduction in numbers of large perch caught and the trade in juvenile *Lates*. Local fishermen have noticed the changes in the composition of their catches, and a few have even voiced their belief in the need for management through regulation to U.N. fisheries project staff (Appleton 1993).

Currently, some biologists believe that the growth curve for the perch has hit its peak and is on the decline. Though the perch have seriously depleted haplochromine stocks and are feeding on the minnow *Rastrineobola argentea*, benthic shrimp *Caridina spp.* and even their own offspring (Ligtvoet 1989), I regularly noted the presence of some of the endemic fish species feared to be

"extinct" among the catches on the western shore in 1993 and 1994, albeit in small quantities. It is possible, and to be hoped, that the cichlid species will recover and over time strike a prey-predator balance with the perch. While the boom in perch catches may not continue, the return of locally valued fishes will be welcomed by local consumers.

Conundrums and Contemplations

Close analysis of the perch problem leaves the researcher asking a variety of complicated, and perhaps rhetorical, questions. For example:

- Should a species introduced to an ecosystem it inhabited thousands of years earlier be considered "exotic," and does its previous interactions with indigenous species have any bearing on how it interacts with species today?
- To the fishing communities and the state government, the economic value of the lake is much higher since the perch was introduced, but is the cost of intensified social stratification and loss of protein from the diets of local consumers worth the gains?
- Would the benefits that women enjoyed as they became involved in the fish-processing and marketing sector of the fishing economy have been greater if, firstly, the high prices of the perch resulting from its trade overseas and, secondly, the negative experiences with co-operatives during Tanzania's socialist period had not caused the women to compete with one another instead of working together?
- Has the existence of a wide variety of lacustrine microhabitats along the vast shore of the lake stymied scientists' abilities to predict the direction of the future dynamics of the lacustrine ecosystem and the potential impacts on the human populations that depend on the lake for their survival?

The following final case study encapsulates many of the problems embodied in this most complicated of fishery systems.

Case Study 4

Mama Eveta used to fry and smoke perch to sell until the competition with local traders from the islands forced the price of the fresh fish out of her reach. "I started in 1993, because I lived near the lake, fish were available, and you could make a good profit," she explained. "But now the situation is . . . different," she added. "Now I buy and sell medicine for livestock. My husband [who is a government livestock field officer] helps me." Eveta was able to provide her family with new bedsheets and clothes and cows which supply milk for the household. "I would like to expand my medicine business, but I don't want money from a bank. The conditions are too difficult. I haven't seen many other women borrowing money from banks either," she said, shaking her head. "Wives can do things for the family, too, you know, not just husbands. My husband's salary isn't big enough to support our family well. Please don't forget women, because women have no power without money!"

The nature of the historical and processual ecology of the western shore of Lake Victoria—complex, dynamic and site-specific—defies all attempts to make generalizations about the relationship of Kagera residents to their environment that will remain valid over time. This analysis of sudden, repeated and catastrophic changes, whose outcome was not predictable and whose ultimate consequences are still emerging, provides us with an important counter-image to the view of people and ecosystems in pre-industrialized nations as static and stable, or linear and progressive. The push by industrialized nations through development organizations to modernize world fisheries, that is, to increase productivity and efficiency through the introduction of new technologies, began in the 1960s and 1970s (Bailey 1988). For the most part, this was achieved by introducing outboard engines, better nets and "improved" fish stocks that have allowed fisherfolk both to extend the range of their capture activities and to increase their yields. In some instances, these changes have improved the standard of living in fishing communities, enabling fishermen to invest in agricultural pursuits (Cole 1991), for example, or to integrate themselves better into the larger community (Ward 1967), and allowing women to gain authority by generating and controlling their own income (Pratt 1995). As this story demonstrates, however, the important challenge that must still be faced is to determine how an increasingly valuable natural resource can be managed over the long term to benefit more than just a privileged minority.

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