AQUANEWS

Sustainable Aquaculture for a Secure Future

AQUACULTURE COLLABORATIVE RESEARCH SUPPORT PROGRAM NEWSLETTER

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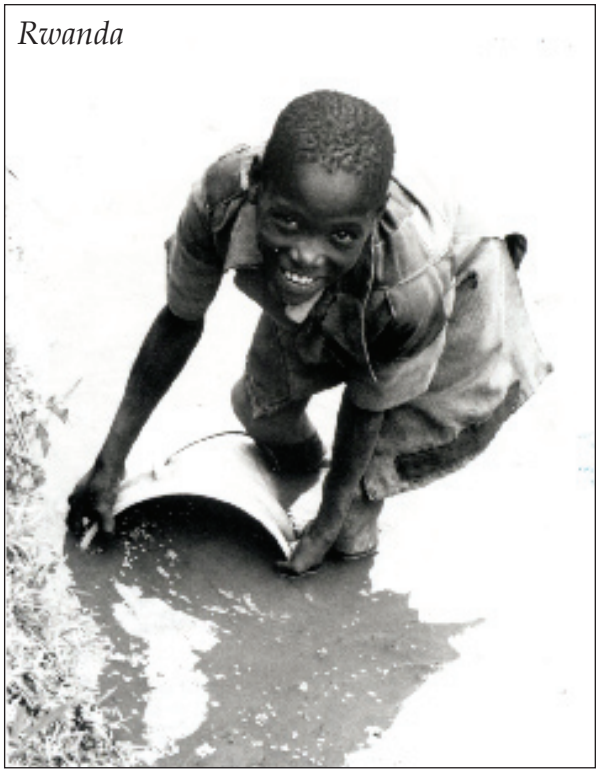

Rwanda

Mexico

Thailand

ACRSP says, "Good night"

By DD Bixby
Oregon State University

This year's annual Aquaculture CRSP meeting, held in San Antonio, Texas beginning 24 February 2006, signifies the close of this 24-year international organization.

The program began in 1982 and has been active in more than 25 countries spanning four continents. Although research and development are paramount in the program, the individual connections of researchers and participants have made significant personal impacts, too.

"Many of us have worked together for 20 years, and so many of those rough edges are smoothed out, and we work really well together," said Program Director, Hillary Egna. "It's just sad we're not going to have another 20 years."

The annual meeting is the only meeting in which most ACRSP participants are able to meet face to face, Egna said. And, in addition to regular business meeting items, the meeting will include discussions on wrapping up ACRSP

*... **ACRSP** Continued on page 3*

New CRSP program begins

OSU News and Communications

An $8.9 million USAID grant for aquaculture and fisheries was awarded in September.

The grant will become part of the Collaborative Research Support Programs network. It is designed to reduce poverty by improving access to fish and water resources.

Oregon State University, which manages its predecessor program Aquaculture CRSP, was named lead institution again for the newly minted Aquaculture and Fisheries CRSP.

"Poverty remains the single biggest threat to children's health today, and giving the poor better access to well-managed water resources can help toward the eradication of poverty," said Hillary Egna, program director of both the ACRSP and new A&F CRSP.

As a lead institution, OSU will partner with other institutions and universities globally to develop an interconnected network of researchers and projects.

"Our goal is to create global partnerships that develops sustainable solutions in aquaculture and fisheries for improving health, building wealth, conserving natural environments for future generations and strength-

*... **NEW** Continued on page 6*

Graduate student profile: James Bundi Mugo

By James Bundi Mugo
Moi University, Kenya

James Bundi Mugo was born in the central province, Kirinyaga District, in Gichugu Division, Njuki-ini location, Mirichi sub-location, in Kimweas Village, Kenya. At age 3, Mugo's family moved to the Mwea Division in Marura village where he joined Kangiciri Primary School. After classes, Mugo spent his afternoons fishing with other children. They fished with either hook and line or sisal thread sacks in rice field canals while grazing cattle. Every fish caught was roasted and eaten at the site, except in the case of a big catch, which was taken home for the family. Because of its delicacies and its acceptance in Mugo's family, fishing became routine work for him as a youth. After his graduating, Mugo decided to pursue a Bachelor's of Science degree, specializing in fisheries. The driving force behind his decision was his belief that one's interest at young stage are a determining factor in what that person will most likely becomes later in life. The fisheries courses became more interesting after his first assignment at Sagana Fish Farm in 2001.

Mugo worked with Aquaculture CRSP from April 2001 to 2003 as an assistant to the outreach and resource people during short courses on pond design, construction and management offered to fisheries officers and fisheries assistants. From this work Mugo gained a lot of practical experience in pond construction. The result of his experience was the construction of three ponds at his home (two measuring 100m^2 and one at 50m^2). These ponds are stocked with Nile tilapia, catfish fingerlings and gold fish. In addition, through the assistance of ACRSP Host Country Principal Investigator, Charles C. Ngugi, Mugo managed to visit Uganda in May 2003 as a consultant for one week. During this visit he assisted the Uganda Commercial Fish Farmers on pond site survey and construction,

Photo by ????

Graduate student James Bundi setting a semi-artificial breeding set-up of African catfish in a pond

hatchery managements and cage farming. In April and July 2005, Mugo participated as a resource person in a hatchery management course for fisheries extension officers, farmers, and fish hatchery managers.

In 2006, Mugo received an ACRSP Scholarship through Moi University for an M.Phil. in Aquaculture. Previous students have already made great strides in addressing major problems in *Clarias* production, e.g., in its culture, low survival rates, growth, etc.; therefore, Mugo chose to work on Nile tilapia and formulated research based on problems facing tilapia farmers. Through the guidance of the ACRSP Principal Investigators, Ngugi and James Bowman, Mugo decided on an investigation and so titled his research the "Effects of dietary protein levels on gonad maturation, age and size at first maturation and fecundity of Nile tilapia (*Oreochromis niloticus*)." Culture of Nile

... MUGO *Continued on page 6*

Goings On …

Congratulations to two ACRSP participants:

Nancy Gitonga, a tireless member of the ACRSP family, retired from the Kenya Ministry of Livestock and Fisheries Development, Fisheries Department. Nancy worked at the ministry for ***(#?)*** years and was actively involved with ACRSP projects for ***(#?)*** years. Congratulations Nancy, and happy retirement.

Chris Bridger, recently the ACRSP Research Projects Manager, has taken a post in (town/province), Canada, as the new (position name?). Congratulations Chris, and good luck with your exciting new endeavors.

ACRSP welcomes two new members to its team:

Betty Nyandat, who has worked for the Kenya Ministry of Livestock and Fisheries since 1985, will take up the reigns for Nancy as the ACRSPs new contact within the ministry. Welcome Betty!

Karl Kosciuch recently received his Ph.D. in Biology from Kansas State University. Karl is taking up Chris's post and will be managing the ACRSP research projects. Welcome Karl!

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Tilapia: Biology, Culture, and Nutrition Preface

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06-209

Tilapia, because of their enormous adaptability and ability to reproduce under a wide range of physical and environmental conditions, excellent growth rates on a wide variety of natural and prepared diets, resistance to handling and disease-causing agents, and broad consumer appeal as a food fish, are the most successfully cultured fish species worldwide. Although they are endemic to tropical freshwater in Africa, Jordan, and Israel, their distribution has widened following introductions elsewhere in the early part and after the middle of the twentieth century. They are now cultured in virtually all types of production systems; in both fresh and saltwater; and in tropical, subtropical, and temperate climates. Tilapia dominate both small and large-scale aquaculture in many tropical and subtropical countries, both as a low-priced product for mass consumption as a staple protein source and as a high-value, upscale product for export markets. They are increasingly being seen as the species of choice for intensive aquaculture and are likely to become the most important of all cultured fish in the twenty-first century.

In the past two decades, as a result of technological improvements, tilapia farming has expanded rapidly worldwide at a rate of approximately 12 to 15 percent annually and is predicted to continue to grow steadily for the foreseeable future. During this period, a number of books and conference proceedings dealing with various aspects of tilapia biology, aquaculture, and exploitation have been published. The information contained in these publications has contributed greatly to the successful development and expansion of the tilapia aquaculture industry. In the past few years, however, considerable technological advances have been made, and this book puts together the currently available information on tilapia aquaculture into a singe, comprehensive volume.

The book begins with an exhaustive review of tilapia biology. This is followed by chapters on the prospects and potential for global production, physiological aspects of

***... PREFACE** Continued on page 6*

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Harvest, Handling, and Processing

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06-213

Quality control of tilapia products has been one of the most critical aspects of the success of the industry. Maintaining and improving the quality of the various product forms have been central to the rapid growth of demand for tilapia products in the market. This attention paid to detail starts while the fish are still growing in their various production systems. Processors and farmers work together to ensure that fish are not contaminated by chemical pollutants or by parasites. Virtually all farms check their water sources on a regular basis to ensure high quality. Many farmers now use bird nets or greenhouse covers to keep out birds and other sources of potential contamination. The following are brief descriptions of some of the preharvest and postharvest considerations for growing, harvesting, and processing tilapia.

This abstract was excerpted from the original paper, which was in, C. Lim and C.D. Webster (Editors). Tilapia: Biology, Culture, and Nutrition. Food Products Press, Binghamton, pp. 607-618.

***... ACRSP** continued from page 1*

research and operations.

"This is the twilight year for them," Egna said of ACRSP projects.

To celebrate the end, Egna has asked the lead Project Investigators of each of the 20 or so projects to bring a presentation showing some of the extraordinary work that has been completed, as well as the impact ACRSP has had communities in which it operated.

Ending such a long-standing program will be an emotive event.

"I want everyone to have a really good time, because we may not ever see them," Egna said.

Although ACRSP is officially ending, a new program, Aquaculture and Fisheries CRSP, is beginning.

See "New CRSP program begins" on page 1

Each year the annual meeting includes about 35 currently participating ACRSP members, as well as the EPAC members. The ACRSP meeting precedes the World Aquaculture Society meeting in the same location. The WAS meeting runs from 25 February to 2 March 2006.

As in past years, ACRSP will sponsor several WAS sessions and the pre-conference poster awards (limited to ACRSP participants) and the Best Student Poster awards.

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Farming Tilapia in Saline Waters

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06-211

Although tilapia culture has been limited primarily to freshwater and low-salinity brackish water, a high degree of salt tolerance exhibited by certain species has suggested that they might be cultured in high-salinity brackishwater and marine systems, enabling their exploitation in tropical and coastal areas (Kuo and Neal 1982; Payne 1983; Hopkins et al. 1989; Watanabe, Burnett, et al. 1989; Watanabe 1991; Suresh and Kweilin 1992; Watanabe et al. 1997). In many areas, limited fresh water supply is an important constraint to further expansion of the industry, which will therefore have to turn to mariculture. To date, the most comprehensive research on saltwater culture of tilapia has been conducted with the Florida red tilapia. The objectives of this chapter are to review the biotechnical and socioeconomic data for saltwater culture of the Florida red and other saline-tolerant tilapia, including the areas of hatchery design and management, broodstock husbandry and seedstock (eggs, yolksac fry, and free-swimming fry) production, nursery production of fingerlings, juvenile grow-out in land-based and sea cage systems, disease control, economics, and marketing. Although tilapia are being considered for culture in lagoonal systems where salinities under 15 ppt (Legendre et al. 1989), the present review is restricted to high-salinity culture systems of ≥ 15 ppt, conditions tolerated by relatively few species of commercial importance.

This abstract was excerpted from the original paper, which was in, C. Lim and C.D. Webster (Editors). Tilapia: Biology, Culture, and Nutrition. Food Products Press, Binghamton, pp. 347–448.

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Management of Bottom Soil condition and Pond Water and Effluent Quality

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06-212

Good bottom soil condition and high-quality water are essential ingredients for successful pond aquaculture of tilapia and other species. Some problems with pond soil and water quality are related to site characteristics (Hajek and Boyd 1994). Soils may have undesirable properties such as acidity, high organic matter content, or excessive porosity. Water supplies may not be large enough or the source water naturally may be of poor quality or polluted with domestic, industrial, or agricultural wastes. Even if a good site is available, large inputs of nutrients and organic matter in feeds to enhance aquacultural production can lead to excessive phytoplankton, low dissolved oxygen concentration, high ammonia concentration, poor bottom soil condition, and other problems (Boyd and Tucker 1998).

Many soil and water quality problems can be avoided by attention to site selection, pond design, and pond construction and by the use of moderate stocking and feeding rates. Nevertheless, sites are seldom perfect, and often, site limitations are not adequately mitigated during design and construction. Pond managers also may strive for unrealistically high production. Thus, soil and water quality problems are not uncommon in pond culture of tilapia. When soil and water quality in ponds are impaired, fish suffer stress. This makes them more susceptible to disease, and they do not consume feed efficiently or grow as well as they should.

Effluents from ponds with poor-quality water may have low dissolved oxygen concentration and high concentrations of nutrients, organic matter, and suspended solids. Release of such effluents into natural waters can cause pollution that harms aquatic communities and lessens the quality of water for other beneficial uses.

The purpose of this chapter is to discuss management of soil and water in ponds and to present suggestions for reducing the volume and improving the quality of pond effluent.

This abstract was excerpted from the original paper, which was in, C. Lim and C.D. Webster (Editors). Tilapia: Biology, Culture, and Nutrition. Food Products Press, Binghamton, pp. 449–448.

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Prospect and Potential for Global Production

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06-210

During the 1990s, tilapia products became an important commodity in the international seafood trade. Tilapia farming has grown from an industry based on fish introduced around the world by development agencies to feed the rural poor to highly domesticated livestock production with sales now exceeding $2 billion a year. The description of the tilapia as the aquatic chicken becomes more appropriate every day. As in the case of chicken farming, tilapia farming can be successful on any scale, from subsistence farmers with a few essentially feral fish in a pond to multinational corporations rearing highly domesticated fish with farms and processing plants in several countries. Tilapia have been domesticated more quickly and to a greater extent than any other group of fish. They surpasses salmonids in economic importance in 2004 and may eventually equal the carps.

World production of farmed tilapia exceeded 2,002,087 metric tons (mt) in 2004 (Figure 2.1), with China the major producer and consumer. The mainland provinces' production in 2003 was 897,300 mt, and Taiwan produced another 90,000 mt. Other Asian countries produced 440,000 mt. The United States is the world's major importer of tilapia. Its 2005 imports were 126,00 mt, with a value of $374 million, divided between frozen whole fish, frozen fillets, and fresh fillets. These products represent a live weight of 281,000 mt. Adding the 2005 domestic production of 9,000 mt sets the U.S. consumption of live weight fish at 290,000 mt or 638 million pounds. Tilapia have already become one of the most important farm-raised fish and have an increasing role in the international seafood trade.

Humans living where tilapia are native have consumed the fish for centuries. Many common names are found for the fish across Africa, Asia, and the Middle East. In the 1930s, scientists realized the potential of the fish as a food source, efficiently transforming plant materials to fish biomass. Missionaries and others interested in improving the welfare of the rural poor determined that tilapia could be stocked into ponds and lakes as an additional food source. Tilapia could grow with minimal inputs and still make a high-quality contribution to the diet of poor farmers. Subsequently, tilapia were stocked into countries across the tropics and subtropics, often into reservoirs behind newly constructed dams. Tilapia are adept pioneer fish, efficiently utilizing available resources and capitalizing on new and altered ecosystems. Usually, the native fish fauna had not had time to respond to the new lacustrine environment, and officials felt that they were 'improving' the fish community. With hindsight, it appears that tilapia have acted alongside other environmental changes to contribute to declines in native fish fauna (Pullin et al. 1997).

This abstract was excerpted from the original paper, which was in, C. Lim and C.D. Webster (Editors). Tilapia: Biology, Culture, and Nutrition. Food Products Press, Binghamton, pp. 51–72.

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Marketing and Economics

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06-214

The economic history of the development of the tilapia industry world-wide is a fascinating study of a fish enterprise that has been managed successfully on nearly every scale of business. This by no means implies that all attempts to raise tilapia have been successful, but rather that examples of successful tilapia enterprises can be found over a wide range of sizes, scales, and business organization.

In 2002, tilapia were being grown and sold in 81 different countries, on every major continent, and in tropical, subtropical, and temperate climates. Tilapia are produced by near-subsistence farmers as a savings account for hard times; caught and consumed by subsistence fishermen; raised and sold to local village markets and upscale domestic markets; exported to high-end sales outlets in the United States, Japan, and Europe; and raised by hobby farmers in the United States and Europe. Tilapia are positioned, often in the same countries, as low-priced products for the poor; as ethnic products; and as gourmet, luxury, upscale products for white tablecloth restaurants. Tilapia are raised in virtually all conceivable types of production systems and in both fresh and saltwater. Regardless of an individual's particular perspective, the tilapia are undoubtedly the most ubiquitous, the most successful, and the most adaptable aquaculture species in the world.

This chapter explores the development of tilapia markets, from the early markets that were developed for wild-caught tilapia, home consumption of farmed tilapia, sales to local markets and upscale domestic markets, and export marketing. Issues and challenges related to these various targeted markets are discussed. The costs of producing tilapia on a variety of scales of production and in different production systems are also examined.

This abstract was excerpted from the original paper, which was in, C. Lim and C.D. Webster (Editors). Tilapia: Biology, Culture, and Nutrition. Food Products Press, Binghamton, pp 619–644.

... **MUGO** *Continued from page 2*

Photo by ?????
James Mugo places African catfish eggs in an incubator.

tilapia (females) remains constrained by early sexual maturation, poor spawning synchrony and low fecundity adding to significant reductions in net returns. To avoid these problems, a number of investigations have been directed towards the production of all-male population of Nile tilapia for aquaculture. The technologies used to prevent early reproduction includes hormonal sex reversal, hybridization, intermittent harvesting, manual sexing, use of predators, cage culture in large water bodies, high stocking density, sterilization and the use of YY male broodstock. However, Mugo feels there are some limitations in the techniques involved. Problems include: labor intensive techniques, broodstock contamination, vigilance required in selection and maintenance of broodstock, requirement of high levels of control, and limited consumer acceptance of hormonally sex reversed in countries where it is practiced. Mugo thinks the use of an effective protein level of the diet to reduce incidence of early gonad maturation and increase fish size at first sexual maturation could solve these problems.

Mugo hopes to continue research and further his education in aquaculture after he graduates. "I would also like reaching out to fish farmers and offering technical advice in fish farming," he said.

... **PREFACE** *continued from page 3*

growth, recent directions in genetics, seed production, and hormonal manipulation of sex. The current state of commercial tilapia culture is discussed in three chapters on different production systems: pond production, culture in flowing water, and cage culture. The chapter on farming in saline water presents the most comprehensive review of knowledge about all stages of tilapia production, production systems, and socioeconomic impacts. The management of soil and water in ponds and the improvement of effluent quality to minimize impact on the environment are discussed in the following chapter. Four chapters review current knowledge on nutrient requirements, nonnutrient dietary components, feed formulation and processing, and feeding practices. Common parasites and diseases, as well as their prevention and control, and vaccinology against streptococcal disease, are then extensively discussed. The penultimate chapter elaborates the techniques used for harvest, handling, and processing. The book concludes with a comprehensive chapter on marketing and economics.

This book will be invaluable for students, aquaculture scientists, extension specialists, producers, nutritionists, and feed formulators. Although the information contained in this book can never be complete, it is hoped that the book will fulfill its intended purpose of providing state-of-the-art comprehensive information on the various phases of tilapia husbandry, thus contributing to the sustainability and stimulating the development and expansion of tilapia aquaculture industry.

This abstract was excerpted from the original paper, which was in, C. Lim and C.D. Webster (Editors). Tilapia: Biology, Culture, and Nutrition. Food Products Press, Binghamton, 705 pp.

... **NEW** *continued from page 1*

ening poor societies' ability to self-govern," Egna said.

Asia, Africa, and Latin America and the Caribbean are the target areas of the new program. Each region will receive about one third of the grant monies.

The new program, which is a slight shift from the older ACRSP, focuses on increasing access to water and encouraging the use of aquaculture and fisheries in the development of growing economies.

"We've made a lot of progress over the last 20 years in increasing fish production through aquaculture," Egna said. However, "challenges still remain in terms of pressures from global trade environmental impacts, water use conflicts, and the distribution of benefits."

According to Egna, the progress made with the export-aimed aquaculture is gaining in market impact. This progress, however, doesn't always have a direct impact on the local communities.

Another goal of the new CRSP is to raise the capacity of developing countries to build their infrastructure, Egna said. Training and Education are the main strategies for accomplishing such a goal.

"In one country, it might be access to fingerlings that is the critical roadblock to building aquaculture," Egna said. "In another area, it might be limited educational opportunities for women, where a community-based outreach model could be implemented.

"Ultimately, we want to give producer and other stakeholders in developing countries better options to help their people. Our goal is not to go in there and tell them what to do."

Egna and the OSU based management team of the A&F CRSP have been receiving requests since October and are in the process of approving research proposals. Programs could begin as early as **(WHEN?)**.

Longnose gar as a surrogate species for aquaculture in Mexico

By Marta Jaroszewska
Nicolai Copernicus University, Torun, Poland

Photo by ***?????***
The young specimen of longnose gar (age – 1 year, TL – 25 cm) from the

Responsible aquaculture practices attempt to avoid unnecessary non-native species introduction in order to eliminate possible invasions and possible exposure of parasites and diseases. ACRSP researchers in Poland, the US, and Mexico suggest that the longnose gar (*L. osseus*), the North American species, may be used as a surrogate species for tropical gar *Atractosteus tropicus*. Culture of tropical gar are gaining international interest in Central America, particularly in the states of Tabasco and Cancun, Mexico.

Because of its unique systematic position and ancient origin, considerable morphology and embryology research was done on the Longnose gar in the 19th- and 20th-century; however, the Longnose gar is not a commercially important fish in the US.

Aquaculture of tropical garfish involves rearing of juvenile and subadults on formulated, commercial feeds. Utilization of commercial diets, on which the fish are reared in farms, in ponds and cages, depends on their growth potential. In this respect, females garfish grow faster and live longer than male gar. The growth advantage of females can be utilized by producing all-female progenies, just like in rainbow trout farming, where such techniques have been used for many years.

Currently, The Ohio State University, in cooperation with Universidad Juárez Autónoma de Tabasco in Mexico, are concentrating on pin pointing the time when gar gonads form and hormonal treatment may impact development of testis or ovaries. The first studies on the subject of "generative organs in garfish" were published in 1882 by Francis Balfour in England. He determined that in garfish of 110 mm in length "the structure of the organ is in favor of the view that this specimen was a female". In 1911, Bennet M. Allen from University of Wisconsin, described the first gonadal germ and somatic cells in garfish of 24 mm, and then only in much larger individual of 110 mm total length. This gap in information, frequently referred to as the period of "juvenile hermaphroditism" in early life of fish, is critical to differentiation of the gonads. Our research, after almost 100 years since the latest publication, addresses exactly this period of gar ontogeny.

Cross-section of the gonadal folds in fish at 107 mm TL (3 months old) with visible presumptive seminiferous tubules (arrowheads); Wd – Wolffian duct; GB – gas bladder

In Ohio, studies were conducted on: induced spawning, larval rearing, weaning to formulated diets, and masculinization with 17–methyltestosterone (MT). The priority is to determine fish size (age) when the gender of gonads is histologicaly distinguishable. This is important for determination of the stage at which the hormonal masculinization in this species is possible. The ontogenetical development of gonads in longnose gar in correlation with size and age of fish, is currently being studied. Present activities are focused on description, by the histological methods, of the differentiation and morphology of the primary germ cells and differentiation of the urinogenital morphology of garfish, which is strikingly different than in teleost fish. The picture at left presents the structure of the "presumed" male garfish gonads, with visible seminiferous tubules.

We also examined the alimentary tract, pancreas and liver in relation to live food and formulated (artificial) diets, and more specifically in respect to possible side-effects of MT utilization in longnose gar sex reversal. If successful, we will be able to produce sex reversed, phenotypical male garfish that will produce only X chromosome containing spermatozoa. The progenies of this "neomale" with any garfish female will result in all-female progeny. This is exactly what the farmer of garfish wants for in an intensive tropical garfish culture operation.

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