

| AGENCY FOR INTERNATIONAL DEVELOPMENT WASHINGTON, D. C. 20523 BIBLIOGRAPHIC INPUT SHEET | | FOR AID USE ONLY |
|--|-----------------------------------|-------------------------------------|
| | | Batch #22 |
| 1. SUBJECT CLASSI- FICATION | A. PRIMARY Agriculture | |
| | B. SECONDARY Fisheries--Brazil | |
| 2. TITLE AND SUBTITLE Progress report I on the Brazil aquaculture project | | |
| 3. AUTHOR(S) Lovshin, L.L. | | |
| 4. DOCUMENT DATE 1973 | 5. NUMBER OF PAGES 11p. | 6. ARC NUMBER ARC |
| 7. REFERENCE ORGANIZATION NAME AND ADDRESS Auburn | | |
| 8. SUPPLEMENTARY NOTES (Sponsoring Organization, Publishers, Availability) | | |
| 9. ABSTRACT | | |
| 10. CONTROL NUMBER PN-RAB-350 | | 11. PRICE OF DOCUMENT |
| 12. DESCRIPTORS Brazil | | 13. PROJECT NUMBER |
| | | 14. CONTRACT NUMBER CSD-2270 GTS |
| | | 15. TYPE OF DOCUMENT |

**Progress Report I
on the
Brazil Aquaculture Project
USAID - Auburn University
Task Order No. 8
Contract AID/csd-2270**

Submitted by

**Leonard L. Lovshin
Project Leader**

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Introduction

This first semi-annual report concerns the activities of the Auburn University Contract, Task Order No. 8, Contract AID/csd-2270, during the period June 16, 1972 through December 16, 1972. Chief of Party, Leonard Lovshin representing the International Center for Aquaculture, Auburn University, Auburn, Alabama, arrived in Fortaleza, Brazil on June 16, 1972 to begin a two-year tour of duty working as a consulting fishery biologist within the Convenio, DPAN, a branch of DNOCS.

Objective

To assist the National Department of Works Against Droughts (DNOCS) and other organizations and individuals in increasing available protein sources through the development and implementation of effective methods of intensive freshwater pond fishculture in Northeast Brazil.

Status of Project Upon Arrival

The intensive fishculture research station located in Pentecoste, Ceara, 80 kilometers west of Fortaleza, contained 48 research units consisting of 35 ponds of 0.04 ha area, nine of 0.1 ha and four of 0.5 ha; four ponds of 0.04 ha are under construction. In addition, located at the pond site is a building containing a storage room, an office, a fully equipped laboratory, a wet lab, and eight concrete holding tanks. Water is supplied by gravity flow from the irrigation canal which originates at General Sampaio Reservoir about 30 km from the Pentecoste station. All ponds have separate inlets and drains and to eliminate wild fish, the water is filtered through cement boxes filled with small stones before entering the ponds. The present physical plant must be recognized as the best fishculture research station in South America at this time.

Presently, 21 species of fish, principally from rivers of Brazil and including 4 exotics and three local species of shrimp, are located at the Pentecoste station. Ten species of fish were in preliminary experiments to determine their pondculture potential.

Progress in the First Six Month Period

The author is pleased with the progress attained in the first six months of his tour of duty. Cooperation with the Brazilians within the DNOCS organization has been excellent. The author has divided his time so that two to three days per week are spent at the Pentecoste Research Station helping direct and organize research activities and training Brazilian fisheries technicians in the principles of fishculture and experimental design. The remainder of the week is spent in Fortaleza attending to the duties of Chief of Party. The following are the major accomplishments of the past six months.

1) Construction--The four 0.04-ha ponds under construction upon my arrival were completed and are ready for use. Two, 0.3-ha ponds are now being constructed and should be completed by early January. Following the completion of the above two ponds, plans are for the construction of twelve, 50 m² ponds to be utilized for the reproduction of fishes, as fry holding ponds, and for small scale experimental work. These ponds will complete the construction at the Pentecoste Research Station for the present time as further expansion of the station is limited for the time being by a lack of water in the dry season and by the wishes of DNOCS Directors to expand research facilities to land located below the Pentecoste reservoir dam. The area below the dam has adequate flat land and a plentiful water supply to allow for the construction of a large research unit. The two fishculture units will both be located in Pentecoste about 4 km apart and should be operated as cooperating research units of one Central Research Station.

Nearly completed at the present Research Station is a feed house which will be used to store feeds and feed ingredients and will house the pelleting machine so that test rations can be formulated and pelletized at Pentecoste instead of in Fortaleza.

A wet laboratory has been installed in the area designed for it in the main building located at Pentecoste. The wet lab consists of eight, 500-liter fiber cement tanks with flowing water inlets, drains, and facilities to aerate each tank.

2) Experiments--The following species of fish have been tested or are in the process of being tested for acceptability as a culture fish. Each species is being tested for rate of growth, production, durability of the fish to adverse environmental conditions and handling, and the efficiency of the fish in utilizing pelleted feeds.

The following are summaries of results to date; at the termination of each experiment a more detailed report of the results for each species of fish will be submitted.

Tambaqui (Myletes bidens)--This fish is proving to be an excellent culture fish. Fish stocked at 1,850 per hectare with an average weight of 6 g grew to an average of 936 g in 10 months with fertilization and a low-protein pelleted ration. The fish is easily seined and is very resistant to handling and poor water quality. Tambaqui can live, for short periods of time, in water with less than 1 ppm of dissolved oxygen. Tambaqui feeds well on a pelleted ration and if it can be spawned, should prove to be an excellent addition to the culture fishes in Brazil.

Pirapitinga (Mylossoma sp.)--This close relative of the Tambaqui has also demonstrated excellent potential as a culture fish. Pirapitingas stocked at 2,350 fish per hectare with an average weight of 9.4 g reached an average of 807 g per fish in 9 months with fertilization and a low-protein pelleted ration. Close to 100% of the fish in the pond can be caught with one seine haul. Pirapitinga is also resistant to handling and poor water quality. This fish accepts pelleted feed readily and should prove to be an excellent culture fish if it can be spawned in a pond environment.

Israeli Carp (Cyprinus carpio)--The common carp is one of the most widely cultured fish in the world. It is raised in both tropical and temperate regions around the world and is known for its ease of culture, good growth, hardiness, and lack of spawning under conditions of culture. Israeli Carp stocked at 2,550/ha with an average weight of 33 g reached average weight of 304 g in five months with the addition of a low-protein pelleted ration. While the rate

of growth is not as rapid as that exhibited by Tambaqui and Pirapitinga, Israeli Carp are growing at a rate which warrants further study on their culture potential in Northeast Brazil. The author along with Brazilian counterparts were able to spawn Israeli Carp for the first time in Northeast Brazil both naturally and with the aid of carp pituitary injections. The fry raised from these spawns will be used in future experiments testing their culture potential.

Hybrid Tilapia--Male Tilapia hornorum when crossed with female Tilapia nilotica result in offspring that are 100% males. Thus, when the hybrids are cultured in ponds the difficult problem of over-production of small Tilapia due to the rapid and uncontroled rate of reproduction is eliminated. The technique for producing these hybrids is documented and we were able to produce hybrid offspring with no difficulty. We now have in process, an experiment to test the production of the hybrid Tilapia in culture ponds. We are using a factorial design, three treatments, each replicated three times at two different levels of stocking to obtain statistically valid experimental results. This experiment is being employed to teach the Brazilian technicians how to set up tests and to analyze and interpret results to obtain the maximum amount of scientific information from the data obtained. While it is too early to comment on the growth and production of this hybrid, the author expects that this fish will be used extensively by farmers in the Northeast with the aid of the USAID and DNOCS cooperative fishculture extension program.

Channel Catfish (Ictalurus punctatus)-- At the request of DNOCS and with the aid of Auburn University, channel catfish were sent from the United States and introduced, for the first time, in Brazil at the Pentecoste research station. The

channel catfish is the basis of a large commercial fishculture industry in the United States and the biology and culture techniques are well documented.

The 500 channel catfish we received had no trouble adapting to the water at Pentecoste and fish taken in samples a month after introduction appear to be healthy and had tripled their weight. When the fish reach a suitable size, preliminary production experiments will be conducted and some of the channel catfish will be raised as broodstock for a future source of catfish fry.

Sabalo (Brycon sp.)--Sabalo were received in a shipment of fish from the Amazon Basin in Peru. The fish were stocked in a 0.04 ha- (0.1A) earthen pond at the rate of 8,150 per ha. The sabalo had an average weight at stocking of 3 g. After nine months of growth, with the addition of fertilizer and a low-protein pelleted ration, the experiment was terminated and the fish harvested. Production was 620 kg/ha and the average weight per fish was 84 g. The growth rate of sabalo was slow even when the high density of fish stocked is taken into consideration. The fish readily accepts a pelleted ration and is resistant to handling. Sabalo proved difficult to seine as it readily jumps to avoid the seine. Fish eaten after the experiment proved to be full of small intermuscular bones. It is not yet known if sabalo will spawn under pond conditions. At this time, further studies of sabalo have been set aside to concentrate on more promising culture species.

Mandi Chorao (Pimelodella brasiliensis)--Fry of this species were transported from the San Francisco River and stocked into four, 0.04 ha-(0.1A) earthen ponds at the rate of 3,750 fish/ha. The average size of the Mandi at stocking was 22 g. The ponds were fertilized with triple superphosphate and organic manure and the fish were fed a low-protein pelleted ration at 3% of their body weight. After

286 days, the ponds were drained and the average production was 280 kg/ha with an average weight per fish of 100 g. Mandi fed well on the pelleted ration and proved to be an excellent tasting fish with few bones. Mandi is able to withstand handling out of water but their sharp spines make handling the fish difficult. It is not known if Mandi can reproduce in culture ponds. Slow growth and low productions per hectare have caused further testing of mandi to be suspended until more promising culture species have been investigated.

3) Feeds--The wet laboratory has been used for the testing of different rations on the growth and feed conversion of hybrid Tilapias. A series of experiments are being performed to compare ration formulations at different levels of animal and total proteins so that preliminary evaluations can be made on the growth potential of each ration and the economics of feeding different formulations. Experimental conditions will be kept as constant as possible so that accurate comparisons between feeds can be made. This series of experiments is also being used as a teaching tool to instruct Brazilian counterparts how small-scale experiments in an artificial environment can be used to gain meaningful information with proper analysis of the data and an understanding of the factors that limit experiments of this type.

4) Trip to Belem--A two-week trip to Belem and area was taken in an attempt to capture and transport a species of catfish, Mapara Hypothalmus edentatus) back to Pentecoste for further study. The catfish was successfully captured but the author and Brazilian counterpart were unable to successfully transport the catfish back to Fortaleza. However, much knowledge was gained in the first attempt which will prove very useful when we try again to transport this fish to Fortaleza in 1973.

Participant Training

Four Brazilian biologist working within the Convenio have received 9 months of training at U.S. Universities but none have obtained an advanced graduate degree from a U.S. institution. At this time, two Brazilians are studying English in preparation to go to Auburn University to work on M.S. degrees in fishery biology. Plans are for the two candidates to leave for the U.S. in early 1973 if they are able to obtain sufficient proficiency in English to warrant their departure at this time. If English scores are not up to minimum levels, further study will be necessary and arrival in the U.S. will be at a later date in 1973. The lack of advanced training for Brazilians has been one of the weaker points in an otherwise strong project. The author has had talks with DNOCS officials and an official letter announcing the USAID scholarship for training in the U.S. has been sent to every qualified fisheries worker within DNOCS. Not one additional Brazilian has taken this opportunity to further his fisheries training by accepting a scholarship. The author feels that more participant training at the graduate level is desirable so all efforts to recruit additional candidates will be continued.

USAID Projects Cooperative Program

With the establishment of a Fisheries Studies Program connected with the University of Ceara School of Agriculture, the Auburn University Project and University of Arizona Project have held preliminary talks together with their respective cooperating Brazilian agencies to try and link the University fisheries program with the DNOCS fisheries research program. The establishment of a "convenio" between the two agencies would make the research facilities, laboratory equipment and trained DNOCS personnel available to the University in exchange

for student manpower which can aid in research work while obtaining on-the-job training and a future supply of educated fishery graduates that can be hired by DNOCS as the need arises. Preliminary talks have yielded information but little fruitful results. Neither agency seems to want to be connected with the other at this time and I am pessimistic about the possibility of establishing a convenio between the University and DNOCS in the near future. The University program seems to be concentrating on marine fisheries while the DNOCS program deals with freshwater fisheries. Still, there are enough areas of similarity in both programs that the establishment of a convenio could be beneficial to both agencies. Both the Auburn and Arizona projects will continue to act as intermediaries between the two parties but it is felt by both USAID projects that the actual establishment of a convenio must be left up to the Brazilian parties involved.

Future Plans

1) Present research projects will be continued and other projects initiated as the opportunity and pond space become available. Emphasis will be placed on species selection and production, feeds and feeding, water quality, and methods of fertilizing with organic and inorganic fertilizers.

2) The principle task of the next six months will be to attempt to spawn a number of native and exotic species of fish. Several of the Brazilian species have never been spawned in captivity before. The optimum time of year to spawn these fishes is during the rainy season when mature fish should be at their yearly peak of sexual development. With the aid of injections of fish pituitaries or mammalian gonadal hormones, mature fish can often be made to spawn in environments in which they would normally not spawn. The success of any fishculture operation

depends on a constant supply of fingerlings which can be raised to harvestable size. The importance of this next six-month period can not be underestimated for even the best culture fish is of little value if it can not be spawned under hatchery conditions or the young can not be obtained from rivers or other natural waters in sufficient numbers for stocking.

3) A trip to Manaus with Brazilian counterparts has been planned for early January to try and learn some of the basic biology of such fish as Tambaqui and Pirapitinga. Fish found in abundance in the fish markets will be weighed, measured, and be examined for gonadal development and stomach contents. Fish will also be examined for external characteristics that will allow the separation of male and female fish of the same species. The abundant supply of fish in Manaus will allow the collection of data that is not possible at Pentecoste because of the limited supply of fish.