History of the Aquaculture Program of the LSU AgCenter, 1966-2014,

With Focus on the School of Forestry, Wildlife and Fisheries.

Memoirs of Professor James W. Avault Jr.
Professor Emeritus, School of Forestry, Wildlife and Fisheries,
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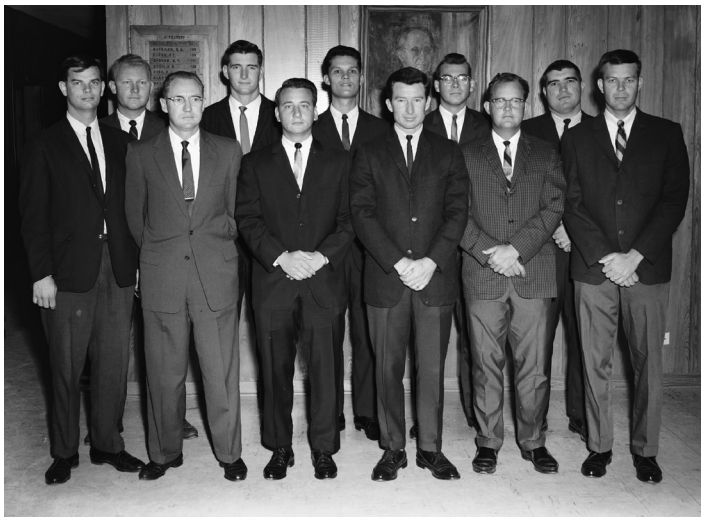
Preface

I came to LSU in 1965 to interview for an assistant professor position in fisheries within the School of Forestry and Wildlife Management (hereinafter referred to as the school). The job opening was revealed to me by R. O'Neal Smitherman, Ph.D. He was a good friend and classmate at Auburn University. We hunted and fished together, and we studied together. He was the leader of the Louisiana Cooperative Fisheries Unit, a federal program of the U.S. Fish and Wildlife Service, housed within the school.



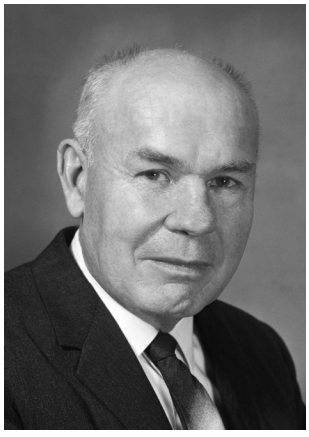
Group picture taken in 1966 of staff and graduate students, School of Forestry and Wildlife Management: from front and left to right, Bill Walker, grad student; Bill Herke, assistant unit leader; Keith Price, grad student; R. O'Neal Smitherman, unit leader; Gus Stacy, grad student; James W. Avault, Jr., faculty; Back row: Rich Tomlinson, grad student; Patrick Ryan, grad student; Harold Loyacano Jr., grad student; Charles Birdsong, grad student; and Laurence W. de la Bretonne Jr., grad student. Grad students from 1966 not shown: Donald D. Turner, W. Ralph Latapie, W. Guthrie Perry Jr., and J. Gaynor Burleigh.

The first interview was with Paul Y. Burns, Ph.D. director of the school from 1955 until 1976. We shared a common interest in the Boy Scouts, and much of the interview focused on this topic. Next were casual visits with Bryant A. Bateman, Ph.D. a forestry professor, and Leslie L. Glasgow, Ph.D. a wildlife professor. Bateman was the founding father of the wildlife program in the school, and he initiated the fisheries program. Glasgow would one day serve as secretary of the Louisiana Department of Wildlife and Fisheries; later he became assistant secretary of the U.S. Department of Interior. The next interview was with Doyle Chambers, Ph.D. director of the Louisiana Agricultural Experiment Station. He, too, put me at ease, and we talked about fishing. In the years to follow, Chambers was supportive of our fisheries and aquaculture program in many ways, such as the addition of new faculty positions. I must have done ok with the interviews because I got the job. It began January 3, 1966, with a salary of $8,400 per year. My first year was spent teaching the three fisheries courses, conducting research and supervising graduate students. When time permitted, I talked with Bateman to learn more about the history of the fisheries program. I also had a keen interest in the wildlife program. In 1966 and again in 1967 I wrote reports to document the early history of fisheries and aquaculture in the school.

This current writing elaborates on those two reports. What follows is an effort to cover certain events that led to the advancement of the fisheries and aquaculture program in the school. A partial list of events includes: addition of new faculty and courses, name changes of the school, initiation of a B.S. and Ph.D. degrees, funding and grants, formation of the Aquaculture Research Station, development of ponds and other facilities, activities with international aquaculture societies, and fisheries and aquaculture research. There are other events, too. No attempt is made to cover them in chronological order because so many of them overlap.

It should be noted that two research stations of the Louisiana Agricultural Experiment Station and seven campus departments have involvement with fisheries and aquaculture. These include the branch stations of the Aquaculture Research Station and the Rice Research

Paul Y. Burns was director of our school from 1955 to 1976. He was a solid supporter of our program from the beginning. His encouragement during the early years was most appreciated.



Bryant A. Bateman was the founding father of the wildlife and fisheries programs in the school. Much of the early history in this report came from him, going back to post World War II.

Leslie L. Glasgow served as assistant director of our school, secretary of the Louisiana Department of Wildlife and Fisheries and assistant secretary of the U.S. Department of the Interior where he was in charge of the National Parks service. He was our mentor throughout development of the fisheries and aquaculture program.

Doyle Chambers was director of the Louisiana Agricultural Experiment Station from 1964 to 1985. By following the state aquaculture plan, he added numerous faculty positions in aquaculture.

Station. The seven campus departments include the School of Animal Sciences, School of Nutrition and Food Sciences, Department of Agricultural Economics and Agribusiness, Department of Biological and Agricultural Engineering, School of Veterinary Medicine, Department of Civil and Environmental Engineering and the School of Forestry, Wildlife, and Fisheries (renamed School of Renewable Natural Resources in 2002). The Louisiana Cooperative Extension Service has responsibility for outreach of fisheries and aquaculture. The Office of Sea Grant Development supports fisheries and aquaculture and wetlands outreach in all of Louisiana's coastal parishes.

This writing focuses on the LSU School of Forestry, Wildlife & Fisheries, and on those stations and departments with close interaction. Aquaculture research in our school was later elevated to a branch station. Note that in this report we interchange the words fisheries and aquaculture. isheries refers to aquatic animals studied in natural ponds, rivers and lakes. Aquaculture refers to the deliberate stocking of aquatic animals in ponds and farming them much like traditional crops such as rice and corn; only aquaculture entails farming in water instead of on land. Further, the word fisheries when used alone, such as in the school's title, covers both natural fisheries and aquaculture. Students entering the fisheries program can choose the natural fisheries option or the aquaculture option.

In the Beginning

Following World War II there was an interest in fisheries to augment the recently formed wildlife program in the school. The first master of science degree in game management was granted in 1948. In 1949 two fisheries courses, Pond and Stream Management 125 and Pond and Stream Management 126, were added to the wildlife curriculum. These two courses were taught by Bateman. Besides the new addition to teaching, an interest was kindled in pond management outreach. Bateman began seining ponds locally and at Hodges Gardens. The ponds were checked for population balance (proper ratio of bluegill to bass), and recommendations were given. Sometimes accompanying Bateman on balance-checks were Ray Allison, who was a Ph.D. graduate student at the LSU Department of Biological Sciences, and Russ Fielding and Bob Webb, employees of the U.S. Fish and Wildlife Service.

With an increasing interest in fisheries, it was decided to hire a faculty member in fisheries. On Nov. 2, 1959, Jess Muncy was hired by the school to teach the two fisheries courses and to organize research. Muncy received the B.S. in forestry and wildlife and the M.S. in wildlife management from Virginia Polytechnic Institute; his Ph.D. was in fisheries from Iowa State College. In his first year teaching, Pond and Stream Management 125 was changed to Limnology 125. When Muncy came here in 1959, there were six graduate students enrolled in wildlife and fisheries. In 1962, the first M.S. in fisheries was granted to Jerome W. Shireman. His thesis was titled "Age, Growth and Gonadal Development of Stripped Mullet, (*Mugil cephalus L.*), in a Freshwater Habitat, Maringouin Bayou, Louisiana", 59 pp. In 1963, Ichthyology 121 was added to the course list. Muncy continued teaching these three courses until June 30, 1965, at which time he resigned and assumed a position as leader of the Cooperative Fisheries Unit at Iowa State University.

From Nov. 2, 1959, until June 30, 1965, Muncy supervised five graduate students. All were granted the M.S. degree in fisheries: 1962, Jerome W. Shireman, listed above; 1964, Wendell J. Lorio, the biology of brown shrimp in ponds; 1965, Jerry Brasher, age and growth of largemouth bass in False River and Old River; 1965, Dudley C. Carver, ecological factors affecting distribution and abundance of the centrarchids of the recent delta of the Mississippi River; and 1965 John R. Kelley Jr., taxonomic survey of the fishes from the Delta National Wildlife Refuge with emphasis upon distribution and abundance.

On Jan. 3, 1966, James W. Avault Jr. filled the position vacated by Muncy. He received the B.S. in agriculture from the University of Missouri and the M.S. and Ph.D. in aquaculture from Auburn University. Experience was received while working at three federal fish hatcheries: Welaka, Fla.; Natchitoches, La.; and Frankfort, Ky.

The Louisiana Cooperative Fishery Unit was established at LSU on June 26, 1963. William Herke assumed duties as acting unit leader. At that time Herke was working on a Ph.D. in zoology at LSU. The word cooperative in the title means that there is a three-way partnership between the federal government that covers the salary and expenses of the unit leader and assistant

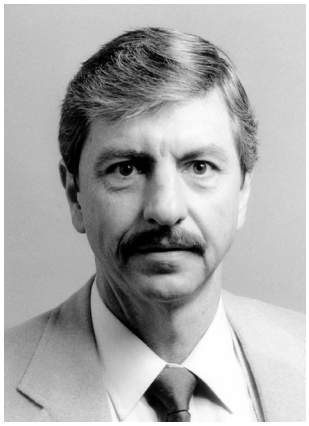
James W. Avault Jr. with a brood channel catfish. He helped develop the fisheries and aquaculture program

unit leader, the school that provides office space and related needs and the Louisiana Department of Wildlife and Fisheries that provides funding for research and student support. R. O'Neal Smitherman, Ph.D. with degrees in fisheries and aquaculture from Auburn University and North Carolina State University, assumed duties as unit leader February 27, 1964, with Herke becoming assistant unit leader. That brought the number of fisheries units in the country to 11. By 1966 there were 23 such units in operation. The unit leader and assistant leader have adjunct faculty status at LSU; they direct graduate student research and they teach.

R. O'Neal Smitherman became the first leader of the Louisiana Cooperative Fisheries Unit in 1964. He initiated the first crawfish research in the School, and he taught students and supervised them in their research.

With the inception of the unit, the fisheries program in the school advanced forward, and long-range plans were formulated. Four students received the M.S. degree in 1966: J. Gaynor Burleigh, the effects of wakefield weirs on the distribution of fishes in a Louisiana saltwater marsh; W. Ralph Latapie, evaluation of various tagging methods on several freshwater and estuarine fishes of Louisiana; W. Guthrie Perry Jr., distribution and relative abundance of blue catfish and channel catfish with relation to salinity; and Donald D. Turner, distribution and abundance of fishes in impoundments of Lacassine and Sabine National Wildlife Refuges. Other students still working on their M.S. degrees in 1966 included: Laurence W. de la Bretonne Jr., food preferences of crawfish; Harold Loyacano, salinity tolerances of crawfish; Keith Price, effects of silvex on fish and fish food organisms; Patrick Ryan, age and growth of spotted bass; Gus Stacy, food habits of bowfin; Richard Tomlinson, food habits of big game fishes; and William Walker, crawfish waste as feed for channel catfish.

With the leadership of Smitherman, research efforts ventured more into aquaculture. Thus the fisheries and aquaculture program was a blend of both natural fisheries and aquaculture. Smitherman resigned his position on June 30, 1967, as unit leader and returned to Auburn University where he joined the faculty of fisheries and aquaculture. Meanwhile, Avault assumed responsibility as major professor for the 11 active graduate students and he began teaching the course in fish parasites and diseases that Smitherman introduced. Smitherman was replaced by Jerry Tash, Ph.D. on Nov. 4, 1967. He received degrees in zoology from Eastern Illinois State College and the University of Kansas. Following Tash's short tenure, Fred Bryan, Ph.D. assumed duties as unit leader.



Fred Bryan was a leader of the Louisiana Cooperative Fisheries Unit. He conducted groundbreaking research in the Atchafalaya River Basin and he was responsible for adding key faculty positions in the school.

Addition of New Faculty and Courses teaching and research faculty

In 1967 I sent a memo to Paul Y. Burns requesting that a new faculty position be added in fisheries and aquaculture. Burns said he had tried to get a new position in forestry genetics with no luck. He did say, however, that he would put in a request for a new fisheries position. From the beginning, and throughout development of our program, you could always depend on Burns for counsel and support.

The position came through, and Dudley Culley, Ph.D. began duties as an assistant professor Jan. 3, 1968. Culley's background was in zoology, with degrees from Millsaps College and Mississippi State University. He began teaching the course in ichthyology and conducting research with pesticides. He also conducted research with bullfrogs. At first, the goal was to produce frogs for food. Later, the focus was to produce a laboratory animal much like the white rat. Culley also studied the growing of duckweed, a small floating plant, in dairy sewage ponds. Duckweed grew on the wastes, thus reducing the organic load. The resulting biomass of

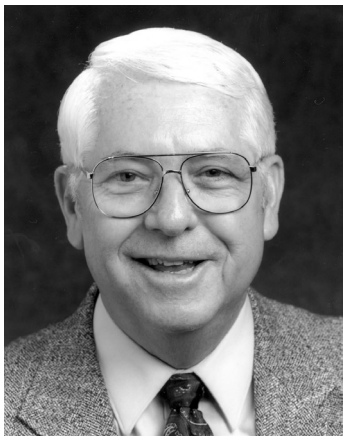
Former grad student and Instructor Laurence W. de la Bretonne, Jr. (dip net) and crawfish farmer. As an extension specialist, you could find his footprints in all 64 parishes where there was an interest in aquaculture.

duckweed was dried and incorporated into experimental poultry feeds.

On Oct. 15, 1966, the National Sea Grant Program was signed into law. This federal program in the National Marine Fisheries Service, Department of Commerce, began establishing Sea Grant Colleges at various universities. There were three levels within the program: The first level considered research grant proposals for funding from individual scientists. The second level recognized a university as somewhat advanced in marine science, and block funding was given. The third level recognized a university as a full Sea Grant College.

This author developed a proposal for a new faculty position in the school and submitted it to W.G. McIntire, Ph.D. in the Coastal Studies Institute. McIntire at the time served as interim director of the incipient Sea Grant program for Louisiana. He included my proposal with others and sent the package to Washington, D.C.. Frank Truesdale, with a Ph.D. in marine science from Texas A & M, filled the new faculty position in 1969. He began teaching and supervising graduate students.

Around 1979 Gerald Wood and John Thibaut came by my office. Both sugarcane farmers from St. James Parish, they wanted advice on crawfish farming. To be specific, they wanted someone to conduct crawfish research on their farms. I wanted to help but didn't have the funds to travel back and forth.



H. Rouse Caffey was chancellor of the LSU AgCenter from 1984 to 1997. He gave support to every aspect of our program.

I suggested that we three meet with Associate Director H. Rouse Caffey, Ph.D. He was always there to offer guidance and encouragement, especially during the early years. He played a major role in development of the aquaculture program of the LSU AgCenter. Caffey had been resident director of the LSU Rice Research Station in Crowley. Now he was associate director of the Louisiana Agricultural Experiment Station. He proposed that a new position in "outfield testing" be established for crawfish research. Simply put, such a position entails conducting research on farms of the private sector. Chambers approved, but he apparently was not aware of my participation in the matter. He called me into his office and asked how I felt about someone else doing crawfish research. I said "just fine."

When the job opening became official, I contacted Robert P. Romaire who was at Auburn finishing his Ph.D. in aquaculture. Prior to that he had received a M.S. degree from our School involving crawfish. Meanwhile, Glasgow said he could solve the Van Conner problem, meaning that Conner could fill the new position. At the time he was working with Bryan and being paid from a grant (soft money). Bryan was doing groundbreaking research with river systems and related areas. Both candidates for the faculty position (state appropriated hard money) gave seminars. Present were several faculty along with Wood and Thibaut. Romaire talked about crawfish farming with slides, and Conner talked about his work in Liberia, Africa. Both gave very good seminars, but Romaire's background with crawfish got him the position and he joined the faculty in the school on Jan. 2, 1980.

With the addition of Romaire to our school, crawfish research took on new life. Meanwhile, Larry de la Bretonne was active in extension. These two were an unbeatable combination. Romaire is a team player all the way. When we later held a field day at Ben Hur Farm, there were a number of tasks that had to be done. When one would be mentioned, he would say, "I'll take care of that." Later, along with Ron Thune, he served as home office advisor for the World Aquaculture Society. The home office was then housed in Pleasant Hall on the LSU campus.

Around 1975 a bill regarding aquaculture was passed by Congress and signed into law. Congressman John Breaux was a co-author of the bill. This was a "feel good" law that in essence said commercial aquaculture had great promise for the United States. No meaningful funding was involved. It was felt that other legislation would follow. It placed the leadership role in aquaculture at the federal level with the National Marine Fisheries Service, with supporting roles from the U.S. Department of Agriculture and the U.S. Fish and Wildlife Service. Breaux, from Crowley, La., was serving as committee chairman of the congressional committee that oversaw the National Marine Fisheries Service. Because of this, he consulted with people of the LSU Sea Grant program

Robert P. Romaire was the first resident director of the Aquaculture Research Station from 1998 to 2007. Through his research, the many needs of crawfish farmers were met.

Rob Reigh is current resident director of the Aquaculture Research Station from 2007 to present. His research helped answer basic questions in fish nutrition.

as well as with people of the National Marine Fisheries Service. A number of people, including this author, were invited to Washington, D.C. to give depositions on the aquaculture law. In essence, I supported the law with one suggestion — that the lead role for aquaculture development should reside with the USDA. Eventually the USDA assumed leadership.

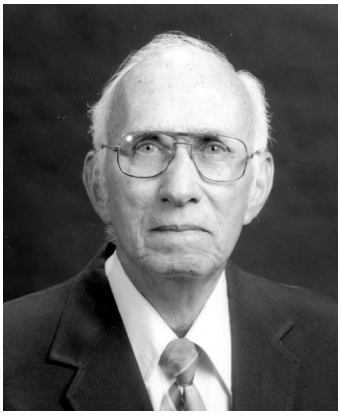
As an aside, Breaux traveled to Kyoto, Japan, in 1976 to attend the FAO United Nations Conference on aquaculture. The first such conference was held in 1966 at Rome, Italy. This author also attended the 1976 conference and served as a session chairman. By attending this conference, Breaux gathered information on aquaculture from an international standpoint. This led to the next development.

This author participated in writing the National Aquaculture Plan. Perhaps the most meaningful part of the plan was the suggestion that states develop their own plans. I felt that could lead to federal funding for our aquaculture program in the school. This was discussed with Leslie Glasgow, and he said "go ahead and put one together." The next step was to visit with a number of people for input, particularly with a select group of aquaculture producers, and with Dave Pierce, the Louisiana commissioner of agriculture.

Shortly, the state aquaculture plan was submitted to the LSU AgCenter's administration and promulgated July 1, 1980. Rouse Caffey had previously suggested that the state plan include the need for a 20,000 square feet. building at Ben Hur Farm. So be it. The guts of the plan identified the need for a number of new hard-money faculty positions. Rather than place all of the positions in our school (empire building), it was felt that additional faculty could best function, and serve the fish farming community, by being housed in LSU departments related to their fields. The state plan ultimately reached Doyle Chamber's office. He mentioned, at an annual faculty meeting of the Louisiana Agricultural Experiment Station , that he wanted to expand the research effort in aquaculture. Shortly after that he called me into his office, along with a few others, and took out the state plan. He used the state plan as his blueprint. He turned to Page 30 of the plan regarding new faculty positions and said, "I am going to add a new faculty position in aquaculture each year to follow this plan," and he did. He then said, "Which position do you want first?"

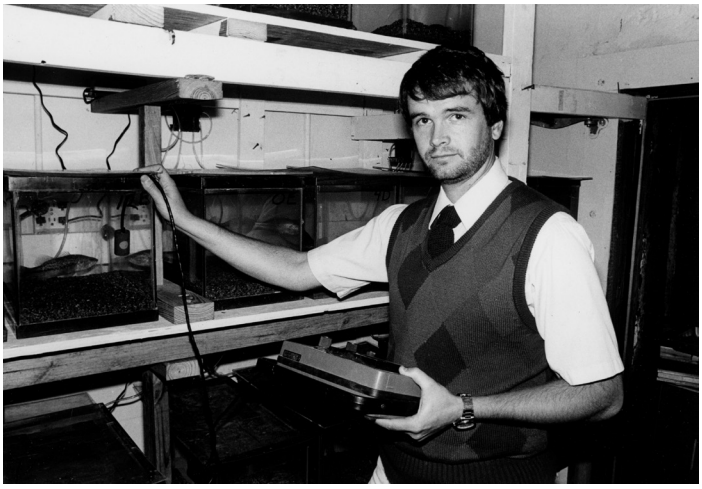
Here is the breakdown: The school hired aquacultural geneticist Bill Wolters, a Ph.D. graduate of Purdue University, in 1982. His initial focus was with catfish breeding, and he later worked with redfish (red drum). Robert Reigh, Ph.D. graduate of Texas A&M University and an aquatic animal nutritionist, was hired by the school in 1986. He began to develop various fish diets. Thomas Lawson, a Ph.D. graduate of University of Maryland and an aquaculture engineer, was hired by the Department of Biological and Agricultural Engineering in 1982. He began to research rotating drums in tank culture for improved water quality. In 1984, Marty Brunson, a Ph.D. graduate of Mississippi State University, was hired by the Rice Research Station to expand the research program with crawfish. Brunson later took a position with Mississippi State University. He was replaced by Ray McClain, a Ph.D. graduate of Texas A&M University, who continued crawfish research at the Rice Research Station. His studies involved relaying (stocking) stunted crawfish into ponds with abundant forage. Further, he began studying various types of vegetation as crawfish forage. McClain also held crawfish field days, sometimes in conjunction with the rice field days. The field day consisted of farmers and other visitors riding on hay wagons around the farm. They observed the latest research with rice and with crawfish. Following that, speakers discussed various topics. J. Norman Efferson, Ph.D. our first chancellor of agriculture, would then give a presentation on the world picture of rice and how it related to Louisiana. A good meal followed.

Ray McClain, of the Rice Research Station in Crowley, studied the relaying (stocking) of stunted crawfish into forage-rich ponds, and he evaluated various forages as food for crawfish. His very popular field days at Crowley allowed crawfish farmers a first-hand look at research.



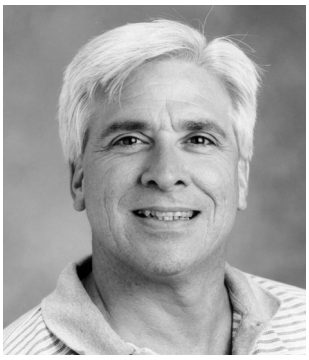
J. Norman Efferson was chancellor of the Center for Agricultural Sciences and Rural Development from 1972 to 1980. He gave our program a solid start by allocating land to construct ponds and other facilities, and he continued his support over the years.

Lynn Dellenbarger, a Ph.D. graduate of



Bill Kelso was the first fisheries professor to serve as director of our school. His research of natural streams answered many questions for their management.

Oklahoma State University, joined the Department of Agricultural Economics and Agribusiness in 1985. Ron Thune, a Ph.D. graduate of Auburn University, was hired by the Vet School in August 1980 to work with fish diseases. He, along with his associate John Hawke, Ph.D. LSU, developed a vaccine for a dreaded disease called enteric septicemia of catfish (ESC). At the time, ESC was responsible for 30 percent of all catfish diseases. These two also set up a diagnostic service for fish farmers. Diseased fish were examined, and recommendations were given. Thune later became an administrative leader in the Vet School.



Allen Rutherford was the second fisheries professor to serve as director of our school, and he is still serving. His research significantly added to our knowledge of the Atchafalaya River Basin and related areas.

Aside from the state plan, Fred Bryan played an important role in obtaining new faculty for natural fisheries. Here are two examples: Through Bryan's efforts, Bill Kelso, Ph.D. graduate of Virginia Tech, and Allen Rutherford, Ph.D. graduate from Oklahoma State University, joined the unit's team. These two played a major role in natural freshwater fisheries research and with the school's administration. Kelso later served as interim director of our school, and Rutherford followed Kelso as director. Later, Kelso and Rutherford were able to add Michael Kaller, Ph.D. LSU to the natural freshwater fisheries faculty in the school.

Extension Faculty

The state plan identified the need for additional extension specialists in fisheries, but it did not spell out specific positions. Some extension positions in fisheries and aquaculture were already in place before the state plan.

Jim Fowler was the first specialist in the Louisiana Cooperative Extension Service for wildlife and fisheries, hired in 1970. He was the catalyst who helped develop the incipient crawfish industry.

Jim Fowler became the first extension specialist with responsibilities for wildlife, fisheries and pests. He joined the Louisiana Cooperative Extension Service in 1970. He has an M.S. in wildlife and a Ph.D. in entomology, both from LSU. Fowler took the program on the road, giving seminars throughout the state for existing and prospective catfish farmers. Avault assisted in the tour. As interest in crawfish farming grew, Fowler helped organize the incipient Crawfish Farmers Association, put out a newsletter, held cookouts and meetings and did whatever needed doing. (As an aside, in 1966 this author attended a meeting of crawfish trappers from the Atchafalaya Basin. We met in Pierre Part. They formed a group called the Louisiana Crawfish Industry Development Association.) In 1976, Larry de la Bretonne Jr., an aquaculture graduate from our School with an M.S. in fisheries with aquaculture specialization, assumed responsibilities for fisheries and aquaculture extension, thus allowing Fowler to focus on wildlife extension. He visited numerous crawfish farmers throughout the state, and you could find his footprints in all parishes where there was an interest in aquaculture.

Over time, Drs. John Cox, Denver Loupe, Jack Bagent and Paul Coreil, all former vice chancellors and directors of the Louisiana Cooperative Extension Service, added new extension specialists in fisheries. Here is a partial list in no particular order: Gary Jensen, Ph.D. joined the extension service while focusing on catfish farming. He later took a position in Washington, D.C., as national program leader with the USDA, where he played a lead role in aquaculture. Both Dwight Landreneau and Ken Roberts ultimately became assistant directors of the Louisiana Cooperative Extension Service. Landreneau also served as secretary of the Louisiana Department of Wildlife and Fisheries. Roberts, an economist, partnered up with Mike Moody of Food Science and Technology. They put on

Dwight Landreneau began as a fisheries specialist with the Louisiana Cooperative Extension Service. The served as assistant director of the LCES, later as overseer of Parks for the state, and then as secretary of the Louisiana Department of Wildlife and Fisheries. His varied experience made him invaluable in helping manage the state's natural resources. (Photo by the LDWF)

Small alligators being grown. The farm-gate value to the state's economy reached $56.5 million in 2012 (LSU AgCenter). Rob Reigh is leading research on the nutritional needs of alligators.

seminars in business and food handling. Paul Coreil later became vice chancellor and director of the Louisiana Cooperative Extension Service. Mark Shirley worked with alligators while at Rockefeller Wildlife Refuge. He assumed a role assisting crawfish farmers. Greg Lutz, Ph.D. became a specialist with crawfish and catfish, and he became the extension leader for the state. Tom Hymel assisted crawfish farmers, and he later worked with technology for mapping crawfish farms. Wendell Lorio, Ph.D. and Jimmy Avery, Ph.D. , both catfish and crawfish specialists, assisted farmers with one-on-one meetings and with group seminars. Avery later assumed a leadership role in extension at the Warmwater Research Center in Stoneville, Miss., an outfield research station of Mississippi State University. Jerald Horst and Rex Caffey, Ph.D. extended outreach to the marine area and coastal zone management.

There were departments involved in fisheries and aquaculture at LSU that were not identified in the state plan for new faculty. This is because they already had strong programs such as the Department of Food Science and Technology.

Former grad student Rex Caffey selects soft-shelled crawfish. He later became a leader as an extension specialist in marine and coastal zone management.

Courses

As noted earlier, in 1966 there were three formal fisheries courses on the books, namely pond and stream management, limnology and ichthyology. In addition, a course titled special problems completed the list. This last course involved a student doing a particular project agreed upon by the student and the professor. In 1967 two courses were add to the curriculum: fish parasites and diseases and fisheries research techniques. Later, more courses were added, including mariculture, advanced aquaculture, fish nutrition, aquaculture genetics and shell fisheries aquaculture.

Name Changes of the School and of Agriculture

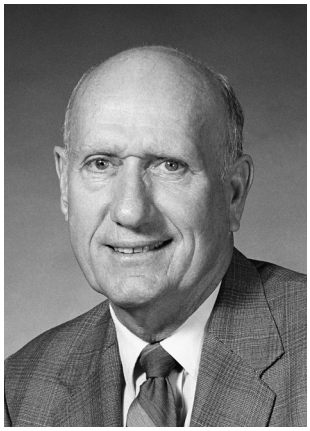
In 1966 the forestry, wildlife, and fisheries programs were within the School of Forestry and Wildlife Management. As the fisheries program grew, it was felt the word fisheries should be in the School's name. By doing so, this would give credit to our growing program, and it would help recruit students. This author requested a name change in 1984 via a memo to Tom Hansbrough, director of our school. Copies of the memo went to the school's faculty. The faculty agreed, and the new name became the School of Forestry, Wildlife and Fisheries. The word fisheries covers natural fisheries and aquaculture. Both have a strong program. A graduate student could choose one of the two areas of specialization. The school's name was again changed in 2002 to the School of Renewable Natural Resources. This includes the disciplines (options) of forestry, wildlife, fisheries and aquaculture, all under one umbrella. The degree is titled renewable natural resources. By combining all options under one head, the number of students enrolled is significantly increased.

Agriculture itself went through two name changes. In 1966 we had the College of Agriculture (teaching), the Ag Experiment Station (research) and the Cooperative Extension Service (extension, i.e. outreach). These programs were housed under the umbrella of the LSU A&M campus. By some accounts, agricultural research sometimes got short changed when it came budget time. One story has it that during a budget preparation, cuts had to be made. By cutting out funding for a proposed beef-cattle building, the budget proposal would balance. At the time the beef-cattle lobby in the state was quite strong; other sectors, such as cotton, were likewise.

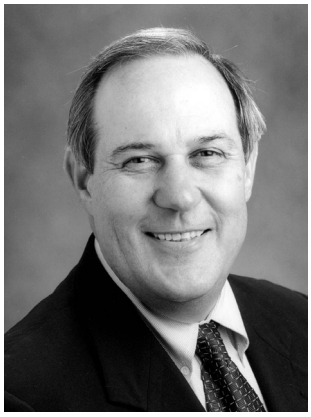
In 1972, thanks to a strong political lobby, agriculture became its own campus with its own budget and chancellor, J. Norman Efferson. Previously he had been serving as dean of the College of Agriculture. The new name for agriculture was the Center for Agricultural

Sciences and Rural Development. The center housed the Ag Experiment Station and the Cooperative Extension Service; at some point an international programs was added. The College of Agriculture remained within the LSU A&M Baton Rouge campus. Howard Hanchey served as dean.

That tongue twister of a new name for agriculture was not used by the media and others. We once hosted Debra Sowers and Ricky Barksdale at Ben Hur Farm. Each episode of their TV show showcased what was going on around Baton Rouge. We wanted to use the name Center for Agricultural Sciences and Rural Development during shooting, and we did. Sowers stopped at one point and asked isn't this research being done by LSU? I later visited with then Chancellor Alvin C. Harper, Ph.D. and told him that the name was too cumbersome to use. Harper became our second chancellor in 1980. No doubt others had told him the same thing. In the end, the name was changed to LSU AgCenter.



Alvin. C. Harper was chancellor of the LSU AgCenter from 1980 to 1984. He provided funds for a fish hatchery, shop and other buildings.

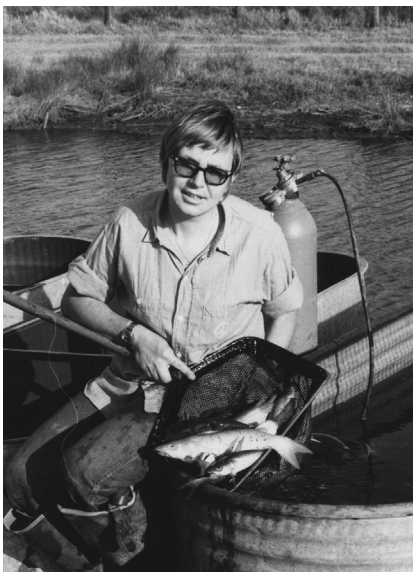


William B. Richardson is chancellor of the LSU Ag Center from 1997 to present. He is skillfully maneuvering the LSU AgCenter through difficult years during a major reorganization of campuses, and he has successfully implemented outreach programs for the public.

Now, changes are coming. At this writing in 2015, the newly installed president of the LSU System, F. King Alexander, is presiding over a major consolidation of campuses and programs. We are most fortunate that Bill Richardson, who became chancellor of the LSU AgCenter in 1997, is helping to maneuver the agriculture programs through these difficult times. It was said "thank goodness for Chancellor Bill Richardson." As chancellor of the LSU AgCenter, his responsibilities included research, extension and the international ag program. He was a former dean of the College of Agriculture. He now also has responsibility for agricultural teaching, plus he teaches a course. With the new reorganization his title has changed. His new title is LSU vice president for agriculture and dean of the LSU College of Agriculture. One reason for consolidation of campuses and programs is the devastating budget cuts to higher education over the years. In deliberating over the restructuring of our university system, we should remember the success story of agriculture and learn from it.

In 1862 President Abraham Lincoln signed the Morrill Act, which created the nation's land-grant institutions. Because of the Civil War, the federal government lacked funds to put into universities. Essentially each state was given a grant of land for higher education. Further impetus for this major legislation was the need for universities to provide education for the average person; thus agriculture was an integral part of land-grant institutions. The A&M, after Louisiana State University A&M, stands for agricultural and mechanical. In 1887 the federal Hatch Act established the Agricultural Experiment Stations and provided a means of funding research. In 1914 the federal Smith-Lever Act established the Cooperative Extension Service. This provided extension specialists who brought research findings into the field. This system of research and extension within the LSU AgCenter has been a huge success. It allows research scientists from different departments to work together in a synergistic manner. The results are disseminated through extension to the private sector — that is, the farmers and other stake holders.

Here are two examples within our aquaculture program. In 1968 we began research in catfish breeding with participation of scientists from various groups: Bill Johnson, Ph.D. geneticist from the Poultry Science Department; William Roberts, Ph.D. geneticist from the USDA bee lab at Ben Hur Farm; Ken Koonce, Ph.D. from the Experimental Statistics Department, and myself from our school. Our goal was to produce a catfish with fast growth, good feed conversion, high dress-out percentage, hardiness in ponds and other desirable traits. Catfish from a number of sources were obtained and crossbred. In 1982, when Bill Wolters joined the faculty of the school, the brood stock produced earlier provided him with a good start toward a superior fish.



Former grad student Edmonde Jaspers assists in harvest of channel catfish. She became a national aquaculture leader in her home country of Belgium.

In 1972 graduate student Edmonde "Mony" Jaspers of Belgium began a study to preserve channel catfish sperm. The goal was to store sperm for breeding purposes, much like that done with cattle and horses. Joseph Roussel of

Terry Tiersch preserves channel catfish sperm. He is a world leader in research with fish sperm preservation. He advises other countries and presents seminars.

Dairy Science was on her graduate committee. He has a long resume when it comes to sperm preservation of dairy cows. Mony was initiating research in a completely new area. Her research led to a Ph.D.

Terry Tiersch, who replaced Wolters in 1992, took this research to a new level. He has an M.S. from Idaho State and a Ph.D. from Memphis State. He has traveled to other countries to assist on sperm preservation. As examples, he traveled to Thailand to preserve sperm of the giant catfish, an endangered species and to lecture on aquacultural genetics. He also lectured at the Chinese Academy of Sciences in Beijing. He coordinated a conference at LSU on sperm preservation. The collection of papers were published in a proceedings, which became the gold standard for sperm preservation of fish. He continues to have follow-up meetings with other experts on the subject.

This synergistic approach to research and extension has resulted in the LSU AgCenter being highly productive. In 2014 Louisiana agriculture products, including forestry, contributed a record breaking $12.7 billion to the state's economy. (Highlights of Louisiana Agriculture 2014 by the LSU AgCenter). Aquaculture and marine commodities both ranked within the top 10. Aquaculture includes alligators, crawfish, catfish, tilapia, oysters, soft-shelled crabs, turtles, minnows and other bait fish. Marine fisheries includes shrimp, menhaden and crabs.

B.S. and Ph.D. Programs

In 1966 the M.S. degree program in fisheries and aquaculture was firmly in place. With an increasing number of students it was felt that we were ready to initiate a Ph.D. degree program. Sometime later we submitted a formal proposal but were turned down. Meanwhile, the recently formed Sea Grant Program, that had virtually no teaching or research faculty, received approval for a Ph.D. program. The key was cross-listing. For example, Sam Meyers, who received Sea Grant funding, was a faculty member in the Department of Food Science and Technology. He was cross-listed as a faculty member with the LSU Office of Sea Grant. There were other faculty who were cross-listed.

An interim solution was to put Ph.D. students in fisheries and aquaculture through the Sea Grant program. Such a student was Ken Allen in 1967. He had a mix of course work from our school and from the Department of Marine Sciences (now the School of Oceanography and Coastal Sciences). Most of the faculty who served on Allen's graduate committee were from our school. Further, his research involved growing freshwater catfish in brackish water. His Ph.D. was listed as marine science.

In the next proposal we submitted, we cross-listed within our own school. Instead of requesting a Ph.D. in fisheries, we requested a Ph.D. in wildlife and fisheries. This got the numbers up. A student then could enroll in the program and choose the fisheries or the wildlife areas of concentration. Over the years the state legislature has weeded out programs that have low enrollment for budgetary reasons. Approval for the new degree came from the Louisiana Board of Regents in 1981.

In 1992 we sought the B.S. degree program. We could not move the proposal beyond our own school, so the proposal sat in limbo. Dr. Mason Carter came to our rescue. He was the new dean of the College of Agriculture. To get acquainted with the various ag departments he made rounds to all of them, ours included. In short, he strongly suggested that we should have a B.S. degree program in wildlife and fisheries within our school. We dusted off our proposal, and within weeks we had the B.S. degree program. Again, the B.S. was listed as wildlife and fisheries, with a student choosing either wildlife or fisheries/aquaculture options as areas of concentration.

Funding and Grants

Paul Y. Burns called a faculty meeting of our school prior to the beginning of the fiscal year that began July 1, 1966. Previously faculty members had submitted their requests for funding. Money for research to our school came through the Louisiana Agricultural Experiment Station. The school also received funding, once in a while, for teaching from the College of Agriculture. The school was not responsible for extension, so the school did not receive funding from it.

Being new to the budget process, I submitted a

modest request. As the budget meeting progressed, Burns noted the requests for funding by faculty exceeded anticipated funding from the Louisiana Agricultural Experiment Station. We had to find a way to lower the school's budget request. Bateman noticed that I had itemized a seine in my budget request. He said "I know where you can borrow a seine, so we can leave that off." I felt rather good that I was helping to balance the School's budget request.

What follows is an account of certain funding and grants that played a significant role in advancing our fisheries and aquaculture program. No attempt is made to list all sources of funding and grants, and there is no particular chronological order.

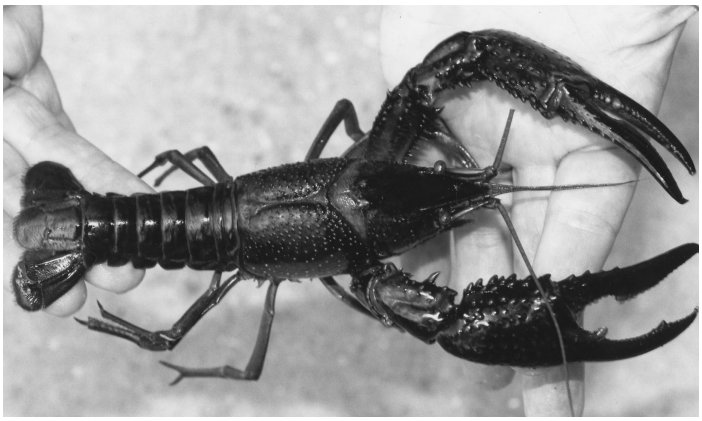
Aquaculture Building

The 20,000 square feet aquaculture building, identified in the state aquaculture plan, was approved for funding. (The building actually turned out to be 22,000 square feet) Each year Chancellor H. Rouse Caffey, who became chancellor in 1984, submitted to the governor a list of new buildings he wanted constructed. Buildings that required renovation were also listed. Caffey met with then Gov. Edwin Edwards. The governor said, "Rouse, you've got a long list of new buildings you want funded; I'm going to give you money for one new building. Which will it be?" Caffey said "the aquaculture building." This building now gave our aquaculture program an identity and a visibility.

Following this, we were told to develop a plan for laboratory and related space. This author convened a meeting October 31, 1985, in room 272 of John Parker Coliseum. The following were in attendance: Bill Kelso, Robert Romaire, Dudley Culley, Ron Thune, Tom Lawson and Bill Wolters. Three suggestions were given for space assignments: First, we needed to assign lab space that covered all the appropriate disciplines in aquaculture, rather than just provide a lab for everyone present. In some cases, faculty might not be on board for certain disciplines. Second, the square footage of space per discipline had to be estimated. Finally, each lab should be adaptable for more than one use. Additionally, attention had to be given to office space, including space for two extension specialists and for secretarial services. Other space requirements also were recognized such as a lounge, storage space, conference room, etc. Once our group put the package together, Dennis Stipe, engineer with the AgCenter, took over.

There is an interesting aside for development of space usage. Graduate student Lawrence Curtis was asked to design and build an aquarium display inside the front entrance of the building. We could then display various aquatic species being studied. Curtis had been a designer and developer of zoos throughout the United States. In the zoo community he was well known. Apparently his entrance into our graduate program was to be the start of a new career. He did design and develop the aquarium display, and it is still here.

He had just gotten started with his graduate work when he came into my office one day for a talk. He said that the crown prince of Saudi Arabia had contacted him to design and build a zoo in Riyadh, Saudi Arabia. He then said, "I'll stay here and complete the graduate degree; I don't want to create a problem for you." I said, "I'm supportive of what's best for you; go ahead and go." He did. Several years later I was asked to give an address at an international aquaculture conference in Riyadh. Here was a chance to see Lawrence and the zoo that he developed. Once the zoo was built, the crown prince wanted him to manage it to get it off the ground. The one day I set aside to see the zoo was the wrong day; it was ladies day, so no men were allowed. Instead we visited a science building that he designed and built.



Crawfish farming in Louisiana had only token acreage in the mid 1960s. In 2014 there were 225,789 acres. Gross farm value was $172,070,345, and total pounds produced were 127,459,700 (Greg Lutz, LCES).

Special crawfish grant

Our first major grant was called Special Crawfish Research Allocation. The state legislature appropriated

James W. Avault, Jr. (left) and former grad student W. Guthrie Perry Jr. harvest fish at Rockefeller Wildlife Refuge. Perry served as president of the World Aquaculture Society in 1981, became director of Rockefeller Wildlife Refuge and was a leader in brackish-water fish culture and in alligator management.

$50,000 in 1966 for crawfish research. O'Neal Smitherman played an important role in obtaining these funds. The University of Southwestern Louisiana said that they located in the heart of crawfish country, so they want half; they got half. The other half came to our school. The money supported two graduate students, and money was earmarked for pond construction. In 1967 the grant was renewed, and our school received $25,000. These funds continued to support the two graduate students, pond construction and a new staff position. Ubaldo Cossio filled this position. His title was ag lab assistant, or simply farm manager.

This special allocation in 1966 and 1967 was important for several reasons. It was earmarked for crawfish research. This offered a solid beginning with crawfish research and training of two graduate students. The allocation also gave impetus to the development of replicated ponds. Now we could conduct experiments and analyze results statistically. Finally, the hiring of Cossio as farm manager solidified our effort to develop ponds and other facilities at Ben Hur Farm. He was at the farm every day, building and supervising what would one day become a world class aquaculture facility.

Grant for crawfish as food

The Department of Food Science and Technology received a grant for $44,000 from the Economic Development Administration of the U.S. Department of Commerce for the study of crawfish as human food. This grant, which came through around the mid 1960s, also involved the Louisiana Cooperative Fisheries Unit in our school. The unit, under the leadership of R. O'Neal Smitherman, focused on biological studies that would lead to production research. Graduate student Cecil LaCaze began this research. He was perhaps the first graduate student in the school to conduct crawfish research. He later became a crawfish biologist with the Louisiana Department of Wildlife and Fisheries.

There was strong interaction between the two groups. Dr. R. Tom Lovell, Ph.D. Department of Food Science and Technology, and Smitherman looked at using crawfish peeling waste as an ingredient in catfish feeds. Crawfish wastes, consisting mostly of shells, account for about 85 percent of the crawfish by weight. Graduate student Bill Walker of the School of Forestry, Wildlife and Fisheries conducted this research. Later, Sam Meyers, Ph.D. Department of Food Science and Technology, studied crawfish wastes from a different perspective. He extracted the pigment astaxanthin which could be added from the wastes, to certain fish feeds. The pigment gives a desirous pink to red color in the flesh of certain fish: such as trout, salmon, kuruma shrimp, tropical aquarium fishes and red sea bream. The latter fish is hailed by the Japanese as food for special occasions. Dr. Robert Grodner, Department of Food Science and Technology, studied the preservation of crawfish tail meat, using various techniques. All of these studies, as well as others, helped to lay a solid foundation for further research by the Department of Food Science and Technology, and it strengthened crawfish research efforts in the School.

Shrimp farming grant

In 1967 this author met with Frank Ritchie, senior vice president of the Louisiana Land and Exploration Company (LL&E). This company is one of the largest land-holding companies in Louisiana. Much of the company's property is marsh land in the southern part of the state. The home office is in Houma. The company did not drill for oil or gas, rather it leased land to others for exploration. It also leased land to fur trappers. By doing this the company helped reinforce ownership of the land. The LL&E land holdings are so vast, it was a challenge to maintain control and prevent others from moving in.

Ritchie had a keen interest for use of surface land. I suggested mariculture, shrimp farming in particular. We obtained a $93,492 five-year grant for shrimp research. The first year $21,700 was budgeted. Then $17,948 was budgeted for each year of the remaining four years. Larry de la Bretonne, instructor of fisheries, was assigned responsibility for the research. He moved to Houma to live, and traveled to nearby Point Au Chien where the project was located.

On Aug. 29, 1967, the LL&E began building ponds with a drag line. The ponds were 40 feet by 109 feet with a three-foot berm inside the levee. Three days later four 0.1-acre ponds were completed. The ponds were allowed to fill by seepage. Following construction of ponds, bare dirt had been exposed on the levees. The crew, living at

the site, broadcasted mustard seed on the surface. Rain brought up the greens, which added to the crew's diet. Some of the men, such as Osee Ray Duhe', pickled 5-inch to 6-inch fish in mason jars; the pickled fish was called bagoon. I was given a jar and that made my day. Again, by having the presence of a crew, the LL&E could reaffirm ownership of the land. Moreover, the LL&E personnel helped with day to day research activities. A cabin on the site had no electricity nor running water. A rain barrel caught water from the tin roof and, then, the water flowed by gravity to a shower and elsewhere. Several bunks allowed a crew to live there.

The first annual meeting (workshop) of the World Mariculture Society was held at LSU Feb. 9-10, 1970. First officers of the newly formed W , from left: Terrance Leary, subcommittee chairman; Theodore B. Ford, president; Samuel R. Monroe, vice president; and James W. Avault, Jr., secretary-treasurer.

As instructor, de la Bretonne spent five years on this project, and much was learned. The project involved two methods for growing shrimp. First was the deliberate stocking of young shrimp into the man-made ponds, feeding them and harvesting them when they became adults. The second method allowed young shrimp to enter the open marsh over a weir. A number of high tides may not at first produce young migrating shrimp. Then, when a certain set of conditions were met, the young shrimp flooded into the open marsh. With a crew living there, this could be closely monitored. The shrimp fed on natural food in the marsh. When they reached maturity, it was time for them to go back to sea. By closely monitoring water-flow, one could determine the migration. Nets caught outgoing shrimp. This method was somewhat similar to that used by some countries such as Indonesia. Young shrimp were allowed to enter milkfish ponds with the tides, and they were later harvested with the milkfish.

Overall our shrimp study provided many benefits. It established our work in brackish-water aquaculture, as well as in freshwater aquaculture. As an aside, Jerry Broom, of the Louisiana Department of Wildlife and Fisheries, conducted shrimp-farming research at the Grand Terre Marine Lab. Concurrent brackish-water research with various species also was conducted at the Louisiana Department of Wildlife and Fisheries Rockefeller Wildlife Refuge. We conducted this research in cooperation with W. Guthrie Perry, Jr., fisheries biologist with the Louisiana Department of Wildlife and Fisheries. The LL&E was pleased with the overall results of our five-year study. However, some commercial shrimpers perceived that capturing young shrimp over a weir took away from their catch. To keep the good will of the shrimpers, the research project was not extended.

Ritchie, with an interest in mariculture, participated in an organizational meeting for those interested in mariculture. This meeting was held in January 1969 on Grand Terre Island. More than 50 people attended. The LL&E provided housing for participants. This exploratory meeting led to the ultimate formation of the World Mariculture Society. At the first annual meeting of the World Mariculture Society Feb. 9 - 10, 1970. The LL&E hosted a seafood banquet in Nelson Memorial on the LSU campus. Richie was later honored by being one of the first Honorary Life Members of the World Mariculture Society.

Funding from Sea Grant

Earlier it was discussed how Sea Grant provided funding for a new faculty position in our School, the Frank Truesdale position. This author also obtained a grant to fund five graduate students in crawfish research. Here is the background: In the mid-1960's unsolicited grant proposals were submitted to the USDA, USFWS, and elsewhere. All came back negative; some gave no response. In 1971 the USDA dedicated its new bee-research lab at Ben Hur Farm. It was called Honey Bee Breeding, Genetics, and Physiology Laboratory. Sen. Allen J. Ellender from Houma attended. He helped secure funding for the building. The senator, at that time, was a senior member of the senate, partly because of his many years of service.

I attended the ribbon-cutting in hopes of talking with Ellender. When asked his advice on funding for aquaculture research and crawfish in particular, he said, "submit your proposal to the Sea Grant Office in Washington D.C." He did not seem to mind that crawfish grow in freshwater not saltwater. When Ellender got back to Washington D.C, he apparently talked with people about the proposal. The grant proposal went in requesting $50,000 a year for two years. The proposal got funded. It provided funds for five graduate students for a two-year period.

Special grant funding from the USDA

In the mid-1960's catfish farming really took off in the South, especially in Mississippi. The catfish lobby in Washington D.C. was quite strong because of two Mississippi congressmen, Thad Cochran and Jamey Whiten. Consequently block funding was received each year for catfish research at the Warmwater Aquaculture Center in Stoneville, Miss.

It was believed we could get such block funding. The groundwork was laid over a period of several years. For example, one year this author served on the review board for USDA grant proposals in aquaculture. The review took place in Washington D.C. The opportunity was taken to visit offices of our Louisiana congressmen. One year copies of our State Aquaculture Plan were dropped off. Eventually the time was right to make a request for funding. I visited with Bill Brown, Ph.D. associate director of the Louisiana Agricultural Experiment Station . While I was still in his office he got on the phone and block funding ultimately followed. There was one stipulation; we could not use this money for catfish research. This stipulation eventually was lifted. Brown was most supportive in so many other ways. For example, he showed his support for our regional 12-state catfish research project by attending out-of-state meetings. He was always there to share his insight with us as our program developed.

Bill H. Brown was director of the LA Agricultural Experiment Station from 2001 to 2004. A strong supporter of our program, he played a key role in obtaining a special grant from the USDA.

This special-grant funding was wonderful because it supported many research projects and continued for 22 years. For many research faculty, it was a major source, if not the only source, of funding. The special-grant funds came through the Louisiana Agricultural Experiment Station . When it received the block funding, all appropriate ag departments were notified that there was a call for proposals. After proposals were received a review committee discussed the merits of each and decided which proposals would receive funding. This was a good thing. It got other departments involved and expanded the aquaculture research base of the Louisiana Agricultural Experiment Station .

Grant from the Louisiana Board of Regents

In 1987 our research facilities at Ben Hur Farm got an upgrade. The Louisiana Board of Regents initiated grants for "equipment enhancement." Grants went to those where a number of departments worked together. To that end this author got faculty together from our School and others, such as Ron Thune from Vet Science. We met in the small office building at Ben Hur Farm. We decided what would not only meet our needs, but also what would be a best fit for the proposal. With that in mind we submitted our grant proposal for $500,000.

We received funding for about $400,000. Part of the money was used to purchase 100 outdoor fiberglass tanks. The tanks were 12 feet in diameter, had electrical hookups for aeration, and had drain pipes. Dirt could be added to all pools, and vegetation was planted. These pools, by their number, allowed us to replicate treatments in our research. Further, grant funds also were used for electricity hook-ups to our existing ponds. Now we could aerate the pond water to improve its quality.

Funds for buildings

Over time a number of buildings were erected at Ben Hur Farm. At one point Ubaldo Cossio had three full-time employees under his supervision. They complained that they had no access to a bathroom. This was related to Chambers, who then provided funds for a bathroom facility. The facility also had a shower, meeting space and a small office for the farm manager.

When A.C. Harper became chancellor of the Center for Agricultural Sciences and Rural Development in 1980, a letter was sent offering our congratulations and he was invited to Ben Hur Farm. Within a week he visited us. We met in the office building of the farm manager. In our conversation, Harper mentioned that he was interested in our possible need for new buildings. He said that he had responsibility for building needs of the LSU system while working in the office of Martin Wooden, president of the LSU System. First, he asked about our budget to run the farm. He was told there was no budget, and we used funds from various sources. He then said "how much do you need?" He was told $30,000 a year, and then on a portable blackboard details were given. Money was transferred to our School. Our School director called several of us into his office and said that he had just received extra money for our program. He then said how it would be used. Wolters had just been hired by the School as an aquaculture genetics assistant professor. Some of the money would be used for his support and for an assistantship. Later, money also was earmarked for new buildings, such as a fish hatchery, a biological research laboratory and a mechanical shop.

Some of our buildings were erected with donated materials. Here are three examples: creosote poles were obtained from Rockefeller Wildlife Refuge, tin roofing was donated from another source, and Fiberglass pools were donated to us from the USFWS at Stuttgart, Ark. Still other materials were donated from various sources. An open-air pole shed with a tin roof was constructed by Cossio with help from graduate students. Various equipment and our tractor were stored here. Our first tractor was a 35 hp Massey Ferguson that we bought on time through plant stores. We bought it instead of other makes because we only had to put 10 percent down. With other tractors it was 15 percent down.

A second building housed the donated tanks. Creosote poles were used for the support; fiberglass sheets covered the outside and tin covered the roof. Jon Goyert, a graduate student, conducted our first experiment with crawfish in this new facility.

We built fish-holding tanks that were used to temporarily hold fish following pond draining. We had creosote poles and tin on hand for the roof. Finally, we salvaged second-hand plywood to form-up for concrete tanks. The tanks had a characteristic wavy shape. The driver of the concrete truck did not know how to control the flow of concrete; the plywood forms filled too fast and bowed out.

Such construction projects occurred before Cossio had a full-time helper. This was solved with help from graduate students. Once a student knew his or her course schedule, it was used to outline their work assignment at Ben Hur Farm. We had work-days on a regular basis. Students helped Cossio erect buildings, mow weeds, lay pipe to ponds and do whatever needed doing. This author also gave of his time at the farm. With a tractor and bush-hog, borrowed from the Louisiana Department of Wildlife and Fisheries, the land behind the 5-acre lake was a jungle and needed mowing. This was before we got our own tractor. Various other work, such as, laying drain-pipe to ponds, could be done in between teaching classes.

Year-end funds

Many of our big-ticket purchases were accomplished with year-end funds. Here is the background: Each year the Louisiana Agricultural Experiment Station anticipated that a number of faculty would retire or accept positions elsewhere. Such faculty could not be replaced the day after they leave. An announcement had to be sent out to advertise the vacant position and interviews had to be given. This took time. Meanwhile, money earmarked for the position was not used but remained in the budget. Sometimes the vacant position was temporarily frozen, or is not filled. These salary savings built up. At some point Chambers, then director of the Louisiana Agricultural Experiment Station , got an estimate of anticipated salary savings. The purchase of big-ticket items that had been planned but put on hold, could be put out on bids. If it was a building, the action required an architect to draw plans.

At one time Ted Nissing of the Ag Engineering Department was the engineer for all ag buildings. Near the end of the fiscal year he was inundated with work. He asked this author if Ubaldo Cossio could help with the drawings. Cossio was a skilled draftsman. Nissing was a native of Nicaragua, and Cossio was from Cuba. Nissing helped us with the first ponds we built. There was common ground. A good relationship developed between the three of us.

Nissing was one of the first to learn when an item was overbid and the amount of money that had been set aside to fund the purchase. I also learned of this. When a piece of equipment, a building, or some other large purchase was needed, a bid request was sent out to companies who handled such items. Meanwhile money was set aside by the Louisiana Agricultural Experiment Station to cover the anticipated cost. The lowest bid usually was accepted. Sometimes all bids came in over budget. If these monies were not spent, they went back to the state. Ed Glaze, comptroller for agriculture, tried to fund requests for year-end funds submitted by others. He told this author that "it (was) not first come first serve." Rather he tried to match the money that had been set aside for a particular item with the cost of the new item requested. We often got advance notice when a bid fell through, and the amount of funds that had been set aside. We then sent in our request for funds that matched the funds that had been set aside for the over-bid item. Sometimes we got bids on a big-ticket item even before we knew if funds would become available. We qualified our bid request with the wording "if funds are available." Sometimes when we got news of bids that fell through for the Louisiana Agricultural Experiment Station , we got in our request only hours later. We simply wanted to help Glaze handle the problem of dealing with year-end funds.

Here are examples of two last-minute purchases with year-end money. The water-well at the end of the 17-acre lake was one of our first purchases. However, we could not factor in the cost to run 3-phase electricity to the well. Cossio found a diesel engine at state surplus. The diesel unit came from a World War 11 PT boat. When you wanted to speed up the engine, you pushed the lever to battle. Over time, our need for a second water well was identified at a Ben Hur Farm Coordinating Committee meeting held Oct. 6, 1994. (see topic titled Aquaculture Research Station)

Another major purchase with year-end funds was for construction of a house at Ben Hur Farm, that Cossio and his family lived in for years until his retirement. The house cost $17,500. Cossio designed the basic floor

plan. Harry Breaux, of Ag Engineering, designed an experimental system to lower the cost of electric bills, heating, and cooling. Advantage was taken of the fact that deep underground temperatures remain stable year around.

Aquaculture Research Station

There were a number of follow-ups to the State Aquaculture Plan of 1980. Here are a few: May 14, 1985, Tom Lawson sent a memo to Dennis Stipe outlining the need for a holding and research facility. A diagram of concrete tanks was attached to the memo. The tanks would: (1) temporarily hold aquatic animals for sorting, weighing, measuring, and examining prior to stocking, and to temporarily hold aquatic animals following harvest, and (2) provide a facility for purging research with crawfish. The need for a new water well was also listed.

July 12, 1985 Avault wrote a progress report on the State Aquaculture Plan. In the report it was written: "It has been five years since the State Aquaculture Plan for Louisiana was promulgated July 1, 1980. As stated then, the purpose of the Plan is to develop a blueprint for development of aquaculture though an orderly and efficient program of research and extension. Much has happened since 1980. New faculty have been added to the Ag Experiment Station and the Cooperative Extension Service. Facilities have been upgraded and new laboratories developed. The Plan has served well as a blueprint." Following this introduction, the progress report then listed priorities for the coming years, including addition of new faculty.

As our aquaculture program grew, there was a need to bring diverse groups together in a cohesive manner. Therefore on Jan. 9, 1987 the Ben Hur Farm Coordinating Committee was formed as an interim solution. Faculty from several departments, who conducted research at Ben Hur Farm, were members of the committee. Meetings were held every two months.

As an example, here is an abbreviated list of topics for a meeting held Oct. 6, 1994 at the Aquaculture Research Building: truck needs for hauling fish, Avault; update on water quality lab, Stan Carpenter (director of our School) and Stipe (assistant experiment station director); assistant professor position to replace Dudley Culley, Avault and Carpenter; report on water use in labs at the building, Doug Drennan; cutting down on dust of shell road, Jerry Berggren (resident director of the Central Stations); office availability in the building, Lolyd Morgan (custodian); publication date for the brochure revision, Terry Tiersch; School matters, Carpenter; Central Station's matters, Berggren; building matters, Morgan; farm matters, Jay Stander (farm manager).

To elaborate on just one topic, Vernon Pfister, research associate, told how much water was needed for crawfish research in the six D ponds. With the continued expansion of pond construction, it was getting more difficult to obtain sufficient water for everyone's needs. As one of our priorities, determined at the meeting, Avault said that he would discuss a new water well with Dennis Stipe.

At this meeting Avault announced that Dec. 2 H. Rouse Caffey will be honored during the crawfish field day to be held at the Crowley Rice Research Station. This is not a retirement party, just the aquaculture people saying thanks. A date and time for the next Ben Hur Farm meeting was set for Dec. 15, 1994.

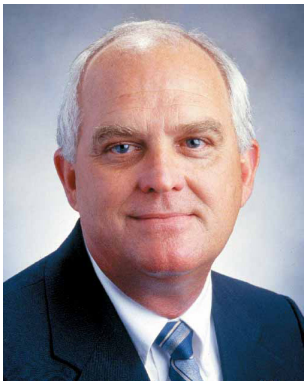
The minutes of the meeting were distributed to the following personnel: Central Stations Farm and the Louisiana Agricultural Experiment Station , Berggren, Stipe, Morgan, Stander; Veterinary Science, Thune, Cooper; Ag Engineering, Lawson, Wells; Cooperative Extension Service, Lorio; School, Carpenter, Avault, Cooley, Pfister, Reigh, Romaire, Chabreck, Pursley, Tiersch, Williams; Civil Engineering, Malone, Drennan, Rusch.

September 30, 1987 aquaculture faculty from several departments requested a meeting with Louisiana Agricultural Experiment Station administrators to discuss the future direction of the fisheries and aquaculture program. Oran Little, then director of the Louisiana Agricultural Experiment Station , called a meeting for Oct. 22, 1987 to discuss this matter.

July 1, 1989 Avault wrote a second progress report on the State Aquaculture Plan and the future needs of the program. In the report a number of new faculty positions were identified: production systems in mariculture, fish physiologist, microbiologist, engineering in mechanics, and production economics.

Here is a section of this report that focused on reorganization of the program itself: "Currently the Ag Experiment Station's aquaculture program is loosely joined among a number of departments, and often new technology developed is not clearly identified with the Ag Experiment Station. It is suggested, therefore, that the aquaculture program at Ben Hur Farm, including related aquaculture programs, be developed along the lines of a Branch Station. With the construction of a new aquaculture building an opportunity arises to consolidate."

In 1998 the Louisiana Agricultural Experiment Station , under the leadership of Director Larry Rogers, Ph.D. established the



R. Larry Rogers was director of the LA Agricultural Experiment Station from 1996 to 2001. He established the Aquaculture Research Station at Ben Hur Farm in 1998, a branch station.

Aquaculture Research Station at Ben Hur Farm. This then brought the number of branch stations around the state to 21. Examples are the Rice Research Station in Crowley, and the Sweet Potato Research Station in Chase. All branch stations are administered through the Louisiana Agricultural Experiment Station . The creation of the Aquaculture Research Station removed the aquaculture research program from the School, and in so doing aquaculture research now had its own identity and budget.

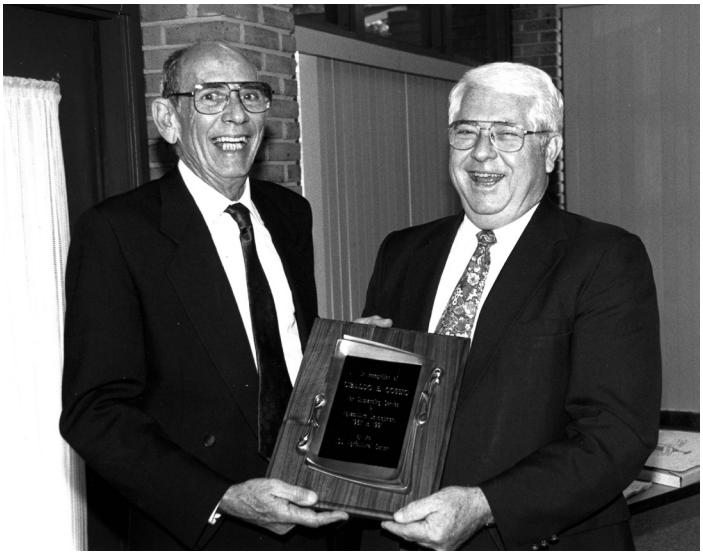
Robert Romaire became the first resident director in 1998 and held that position until 2007. Under his leadership aquaculture research continued to advance. Robert Reigh assumed the position in 2007. Greg Lutz, cooperative extension specialist, is housed in the aquaculture research building. This continued a trend of housing extension personnel and research personnel in the same building. A trial ballon for this consolidation probably began with horticulture scientists. It has worked out well.

Ubaldo Cossio

Ubaldo Cossio played such a major role in developing our aquaculture facilities at Ben Hur Farm that it merits some detailed discussion. In 1959 when Fidel Castro took over Cuba things changed for Cossio and his family. He worked for the highway department and construction companies for many years. Further, he raised unique cattle through years of selective breeding. One day some of Castro's men came to his ranch and said that they were going to seize his cattle. Knowing it was hopeless to resist, Cossio said take them but don't kill them; they are specially bred. The cattle were killed anyway. He was told that all men and animals are equal under Castro. At some point Cossio decided that it was time that he and his family leave Cuba. He had to wait five years before he had permission to leave Cuba. They started the long process of coming to the United States with a mandatory nine-month stopover in Mexico. His wife Aracelis had a brother living in Baton Rouge, so they made their way here in 1966. He needed work, and Aracelis was also looking for work. In Moron, Cuba she was a school teacher who devoted her life to helping others. Aracelis had a contact, originally from Cuba, who worked at Goudchaux's/Maison Blanche department store. She went there seeking work. She was told that they needed a seamstress; could she alter suits and dresses. She said, "Yes, I am good at that." She got the job, and worked there a number of years until retirement.

Meanwhile Cossio had a contact at LSU, sort of. Aracelis' brother, Edmundo Robaina, was working on an M.S. degree at LSU. His wife worked for Bill Johnson of Poultry Science. Johnson told Robaina that Ted Nissing of Ag Engineering was looking for someone to hire. When visited, Nissing said the money did not come through for the job, but he referred Robaina to me. When Robaina came to my office, he was told about the job that was available. Actually the only money we had at the time was hourly-wage money, and Robaina was told this up front. When asked what Cossio could do, he said "he can do anything." Cossio was hired. The following year, Oct. 9, 1967, Cossio was appointed Ag Lab Assistant (farm manager), a permanent position. Over the years to follow it was learned that Cossio could indeed do anything, as you will see as we walk you through the development of facilities at Ben Hur Farm.

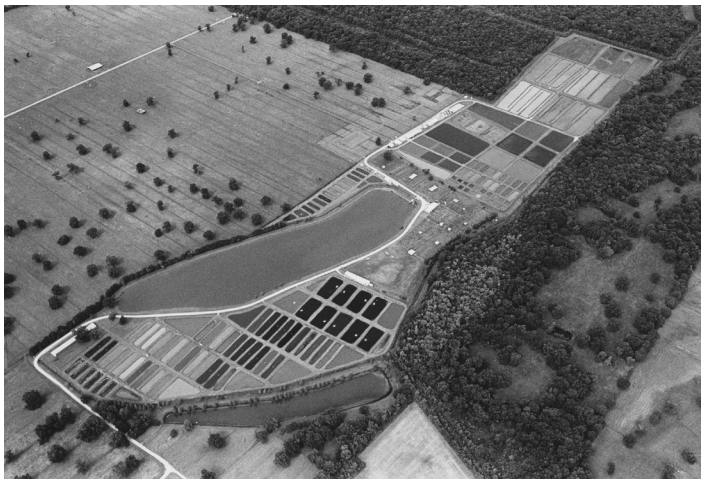
The first day that Cossio came to work we had a problem understanding each other; he barely understood English. A stick was found and used to draw pictures in the dust, and there were other means to communicate. He understood the work for that day. When I came back to the farm after teaching, he was mowing grass with his brother-in-law's push-lawn mower. It was then suggested that we both get to know the other farm managers at Ben Hur Farm. We visited farm managers of sheep, cattle, hogs, and horses.



Ubaldo E. Cossio, aquaculture farm manager from 1967 to 1991, receives the Outstanding Service Award from Chancellor H. Rouse Caffey. He played a major role in development of a world-class aquaculture facility at Ben Hur Farm.

One day Cossio asked about the bulldozer that was sitting idle in a field across from Ben Hur Road. He said that he could operate it and do any repairs needed. The bulldozer was a World War II model, cable operated. We learned who had the bulldozer. It was Carl Camp and Cade Carter of the USDA, who were housed in the Department of Ag Engineering. They said "go ahead and use it, we'll let you know if we need it." At the time we did not have enough money to buy diesel fuel. Reynolds, sheep-farm manager, donated a 55-gallon drum of fuel. Cossio built his first pond. Later to show our thanks to Reynolds, we provided pine seedlings which were planted along the road by the sheep farm. It's good to be in a department with foresters. As an aside, in 1967 Cossio and I planted cypress seedlings along the banks

of the 17-acre and 5-acre lakes. Over time Cossio did all of the electrical wiring at our farm, carpentry work, plumbing, surveying of ponds, bulldozer operation and repair, and tractor work; he did it all. Sometimes he assisted other farm managers at Ben Hur Farm. That's the way it should be.



Research ponds at Ben Hur Farm, LSU AgCenter

Ben Hur Farm Ponds

O'Neal Smitherman took me to Ben Hur Farm a few days after my arrival at LSU Jan. 3, 1966. Ben Hur Farm is south of the main campus, down Nicholson Extension, and across the railroad tracks. The farm backs up to the River Road which parallels the Mississippi River levee. At the time, the Louisiana Agricultural Experiment Station was doing research with hogs, sheep, beef cattle, dairy cows, and horses. There also was horticulture research. We saw a 5-acre lake, (L-2), then went through two cattle gaps until we came to a 17-acre lake, (L-1). Alongside of the lake was a muddy road that led back to deer pens where research was being conducted by John D. Newsom, leader of the Cooperative Wildlife Research Unit. His research, and that of students, produced results that benefited deer management throughout the United States. To the right of the muddy road was a large open field. Beyond the deer pens was pasture land dotted with trees. There were no buildings or storage sheds on any of this land.

On the side of L-1, adjacent to a fence, was an area with 11 ponds about 0.1 acres in size. These ponds are believed to have been built by the Louisiana Department of Wildlife and Fisheries. We named them M ponds for miscellaneous because of their varied size and shape. The ponds had no visible means of getting water and no way to drain them by gravity. Drainage ditches ran between rows of ponds. Later in research, we used 2-inch and 3-inch Wisconsin pumps to drain the ponds.

March 11 and 12, 1966, 6-inch irrigation pipe was laid above ground from an existing water well, located just across Ben Hur Road, to the M ponds. The pipe was donated by the Louisiana Department of Wildlife and Fisheries. This made water available to all of the M ponds for the first time. Formerly water had to be pumped or syphoned from L-1. This method was very inefficient. Consequently only one or two ponds had been used. The others grew up in weeds.

Our first experiment in these ponds was with catfish. A day or two before it was time to pump down the ponds and harvest the fish all of the ponds went dry. The pond levees held logs and trash from trees. As they rotted the levees became porous. Sometime later we renovated the ponds; the ditches between ponds were closed, and pipe was laid.

Adjacent to the M ponds we erected 84 vinyl-lined pools. They were 10-feet in diameter and 36-inch deep. These pools allowed us to set up experiments with replicated treatments, since we had no replicated ponds.

Meanwhile, construction of brackish-water ponds had begun at Rockefeller Wildlife Refuge in Cameron Parish. During 1966, 40 one-tenth acre ponds were constructed under the supervision of Bob Chabreck, director of the refuge. The ponds were built with a marsh dragline, since a bulldozer would sink in the marsh. Dec. 1, 1966 W. Guthrie Perry, Jr. was hired by the refuge. Perry's research in brackish-water aquaculture set the pace for others to follow. He began conducting pond research with a host of aquatic species, such as pompano, croaker, mullet, prawns, and he pioneered growing freshwater catfish in brackish-water ponds. In 1981 he served as president of the World Aquaculture Society. We conducted cooperative research with Perry. The Louisiana Department of Wildlife and Fisheries provided grants to us for graduate students. This arrangement went on for a number of years.

Back to Ben Hur, we still needed replicated ponds for research. Perhaps a brief explanation is in order to explain the function of replicated ponds. Assume that we want to compare a new fish- feed with a standard feed that has been in use for years. Two ponds are stocked with fingerling channel catfish, and the fish are fed the new feed in one pond and the standard feed in the second pond. Fish are grown to market size. We cannot draw statistical conclusions as to which feed is best to grow catfish. If, however, we use the new feed in four ponds and the standard feed in four other ponds (control) we can draw statistical conclusions. This idea, replication of treatments, has been used in agriculture research for many decades. H.S. Swingle of Auburn University began using this method for aquaculture back in the 1930s.

Dec. 15, 1966, this author submitted an unsolicited request to J. Norman Efferson for land to construct ponds and ancillary buildings at Ben Hur Farm. To

justify the request, an economic comparison was made between traditional crops, such as cotton and rice, with aquaculture crops. Avault sought input from Bill Bolten, an ag economist who worked for the USDA; he was housed in the department of Ag Economics and Agribusiness.

Efferson approved the request for land by phone on Dec. 21, 1966. He had the vision to see promise for commercial aquaculture in Louisiana, and he took a chance on us. This one act, giving us land, gave our program a solid beginning. The land was about 30 acres and went from beyond the deer pens out into the field. No funds were provided for development.

In 1967 a total of 18 tenth-acre ponds (T ponds) and 18 earthen raceways (R for raceways) were constructed by Stanley Graham and Co. The money for this work came from a state grant mentioned earlier. We laid pipe to the ponds and raceways in 1968. Cossio operated the backhoe to dig trenches, and the students and I laid the PVC pipe.

Further work involved elevating the levee of lake L-1. The water level at the time was even with the road. By raising the levee and water level, we hoped to get gravity-flow water to ponds. Somehow we managed to get a free drag line, with operator, to build up the levee. I was out of town attending a meeting when it happened. The dragline fell into the lake. Smitherman found a bigger drag line to pull out the one in the lake.

Joe Herring served as chief of the wildlife and fisheries division and as secretary of the LDWF. His support greatly helped us develop our pond facilities. (Photo by the LDWF)

The next ponds we built were six one-third acre ponds (A ponds). Joe Herring, chief of the wildlife and fisheries division in the Louisiana Department of Wildlife and Fisheries, provided the bulldozer, operator, and diesel fuel. We developed a very good relationship with Herring and the Louisiana Department of Wildlife and Fisheries, which began with Smitherman and the Cooperative Fisheries Unit. The Louisiana Department of Wildlife and Fisheries has wildlife management areas throughout the state for public hunting and fishing. Bulldozers and other heavy equipment are used to maintain the roads and for construction needs. Again, after ponds were constructed, Cossio dug trenches for water supply and drain lines. The students and I laid the pipe.

We assisted the Louisiana Department of Wildlife and Fisheries whenever they needed help. As an example, at one time there was a big push to introduce the Florida largemouth bass into Louisiana waters. The question was, does the Florida largemouth bass grow large because of the long growing season in Florida or because of genetics. I was fortunate to work with Florida bass in 1959 at the National Fish Hatchery in Welaka, Fl. No doubt, they grew fast and they grew large. Nearby, St. John's River was known for giant-size bass. The bait of choice was an 8-inch to 10-inch golden shiner. The Louisiana Department of Wildlife and Fisheries asked us to compare the Louisiana bass with the Florida bass. We did so in replicated ponds. The Florida bass outgrew the Louisiana bass. However, some said that the Florida bass did not bite the hook well. From my first-hand experience in Welaka, I thought otherwise. Introduction of the Florida bass into Louisiana waters was temporary put on hold. Eventually releases were made into public waters. Moreover, private hatcheries in Louisiana often have both varieties for sale.

The next construction produced only a single pond, B-1. We found a little money and got Stanley Graham to build the pond. After Cossio laid off the markers, Graham's son ran the D-6 bulldozer. Eventually Herring and the Louisiana Department of Wildlife and Fisheries caught up with road repairs and the like and had idle bulldozers. They sent two D-6 bulldozers to Ben Hur Farm. Cossio surveyed, and then laid off markers for eight more ponds.

The next ponds were built, under controversial circumstances, on the large open field adjacent to L-1. The student government association (SGA) had its eye on this same piece of land, and it had political support. The SGA was looking for land near LSU to develop as a park where students could go and relax. I met with representatives of the SGA with friendship at Ben Hur Farm. They were told that the large lake might be used for water skying. I did caution, however, that the lake contained a disease caused by the bacterium *Cytophaga columnaris*. That was a concern of mine. I neglected to mention that this disease affects catfish and not people.

About this time Cossio cleaned out the drainage ditch that ran between the land in question and the 5-acre lake. The spoil was deposited on the land. We borrowed a D-4 bulldozer from the branch station near Clinton. Cossio smoothed out the spoil so that it did not disrupt the land. Shortly thereafter Glasgow asked me to go to the farm with him. He stopped the truck on the road near L-1. He said, "Jim, can you build ponds on this land." I said, "Prof, you know how political this land is." He said, "Go ahead and build them, but build them shallow in case you have to cover them up later." We had no money to build ponds, but the Louisiana Department of Wildlife and Fisheries came to our aid. On the way home after work, I stopped by to say hello to Joe Herring. We talked about hunting as we often did. I said, "Joe, I have

something rather important to ask you. Do you have a dove hunt lined up?" Somewhere in our conversation he said that the Louisiana Department of Wildlife and Fisheries had just purchased a new bulldozer. He felt uneasy because the bulldozer was made in Japan; he knew nothing about the make and model. He had to take the low bid. The dozer was scheduled for work at the Russell Sage Wildlife Management area in Richland Parish. I said, "We can help you. Bring the new bulldozer to Ben Hur Farm and try it out." He sent the D-6 bulldozer to the farm, and the work began. Meanwhile Cossio and the students staked out the whole field. We made no attempt to lay pipe, and there were drainage ditches between each row of ponds. Pipe could be laid later and the ditches closed off. Work had just begun when Herring sent two more bulldozers to the farm. In building these ponds speed was of the essence. In a matter of days the large open field had ponds from one end to the other. We called them C and H ponds. We kept the three bulldozer operators in dressed catfish every Friday afternoon to show our thanks.

The only land left to build ponds was a tract of about 30 acres beyond the last row of B ponds, ponds B-3 and B-9 to be specific. The School finally got approval to hire a forester in genetics. The School's director told the new faculty member that he knew of some land at Ben Hur Farm that might be available for his research. This was of concern to us because we had developed our whole infrastructure at Ben Hur, including ponds, a water well, various buildings, and pools. This author wrote to J. Norman Efferson, and carried the hand-written letter to his office explaining our situation. Meanwhile I had Cossio stake out the whole field, and to have it done by the end of the day. He said that it will take more than one day to survey for ponds. He was told there was no time to survey. Just put up stakes all over the field and use plenty of hunter-orange ribbon. The letter to Efferson must have helped our cause. There were no funds in sight for pond construction, but we had to have some activity on the land in order to show that it was in use.

It was learned that the National Guard had training activities with heavy equipment each summer. The Guard was contacted, and they came out to Ben Hur Farm. We had them take out all of the trees that dotted the field.

One day we saw the Department of Public Works (DPW) at the farm. I met "Safety" Jones of the DPW and made him feel welcome since they had to come through our place. A new subdivision was being built adjacent to Ben Hur Farm, and drainage ditches had to be cleaned out and new ones made. The ditches bordered land on all sides of the area where we hoped to build ponds. The DPW was asked what they were going to do with the dirt that they removed. They said "haul it off." They were told that we could save them the trouble. We rented three 6-yard dump trucks and hauled the dirt to the C ponds

Robert P. Romaire researched a new pass system for growing fish, Ben Hur Farm.

to build up the levees. The year before, heavy rains put water over the tops of the levees and the whole area became one big lake. Students drove the trucks between classes. Cossio smoothed out the soil with a borrowed D-4 bulldozer. Even by hauling off dirt there was still too much left over. It was suggested that the dirt be used to build levees next to and parallel to the ditches being cleaned out. This ring levee became the outer levee of six ponds.

When the Mississippi River rose to a certain level, we sometimes got water boils in the field. This resulted in the DPW vehicles getting stuck. (When the Mississippi River rose high enough, our water-well at the end of L-1 was free-flowing.) It was suggested that a road be built down the middle of the field to avoid this problem. In essence, this road became the spine of the six ponds that were slowly being built.

The men operating heavy equipment did not work over the weekend. We tried to make sure that they had catfish or crawfish to take home every Friday. Until now we had all of the outside levees in place and one down the middle separating the two rows of ponds, but there were no cross-levees. One of the bulldozer operators, who liked to rabbit hunt, and I hit it off real well. I grew up hunting and trapping rabbits. To be brief, he said that he would work on weekends to put in the cross-levees. He did. We now had six D ponds. The D stood for demonstration. The ponds were each about 3 to 5 acres in size and were relatively shallow, just right for crawfish.

International Association of Astacology

Our School has been, and is, involved with international organizations. Perhaps two of the most notable are the International Association of Astacology and the World Aquaculture Society.

In 1972 the first international symposium on crawfish was held in Hinterthal, Austria. Crayfish is the word used in Europe rather than crawfish. The idea for the symposium began when Reinhard Spitzy of Austria

and Sture Abrahamsson of Sweden discussed the growing interest in crayfish. These two men contacted other experts in the field: professor Per Brinck, Stellen Karlsson, and Maja Abrahamsson of Sweden; Professor Tratz of Austria, and other knowledgeable scientists. In short, the symposium was set up. In the beginning it was called Eurocraysymp (European Crayfish Symposium). Later the name was changed to Intercraysymp (International Crayfish Symposium) to reflect three participants from the United States, namely Avault, Charles Goldman from the University of California Davis, and Aubrey Heumann from Louisiana. Goldman supervised Abrahamsson when he was a graduate student at the University of California. The research involved the signal crawfish *Pacifastacus leniusculus*. This species is native to Lake Tahoe and the Sacramento River in California. Heumann was a crawfish processor from Louisiana who came to the symposium in hopes of finding new markets for his crawfish. The symposium focused on two main areas: a devastating disease called the crayfish plague, and introduction of crawfish immune to the plague, notably the Louisiana red swamp crawfish, and the California signal crawfish.

This author was the last speaker on the last day. I discussed the crawfish industry in Louisiana along with our research. Following this presentation, I invited the group to Baton Rouge, Louisiana the next year for a second symposium. This was somewhat of a surprise to those present. It was felt that this was to be a one-time symposium. However the idea caught on, that is suggesting a follow-up with a second symposium. Brinck was made president of the newly formed International Association of Astacology (IAA). Spitz suggested that it might be best that we meet every two or three years in order to give researchers time to generate new information. Further he felt that everyone may not have the means for out-of-country travel every year. The second symposium was then set for 1974.

Overall, the symposium in Hinterthal was a big success. Proceedings of the scientific papers were edited by Abrahamsson and published in a 252 page hard-cover book. Among other things, the symposium brought together scientists from various countries. This interest carried over to Intercraysymp II held April of 1974 at LSU. Countries represented at the 1974 syposium included Ukraine, Poland, Finland, Sweden, Austria, Russia, France, Australia, Canada, West Germany, Nigeria, Spain, Great Britain, Brazil, Mexico, and the United States.

Officers elected were James W. Avault, Jr., president; John Mason of Canada, president-elect; and Ossi Lindqvist of Finland, secretary-treasurer. Serving on the executive board were: Per Brinck, Scandinavian countries; Reinhard Spitzy, western Europe; Josef Kossakowski, eastern Europe; Archduke Andreas Salvador Habsburgo Lorena, Spanish speaking countries; Jack Frost, Indo-Pacific region; Duro Adegboye, Africa and Jim Fowler, North America.

The conference was a big success in so many ways. Spitzy, co-coordinator of Intercraysymp I, made a special trip to Baton Rouge prior to the symposium to assist with final preparations. Proceedings of the scientific papers were edited by me and published in a 676 page hard-cover book. Bonnie Boudreaux designed the book cover. Numerous people contributed in making the conference successful. Fowler was responsible for coordinating the catfish dinner and crawfish boil, both held in the rodeo arena of John Parker Coliseum on the LSU campus. The Louisiana Department of Agriculture and Forestry put on the catfish fry and the Louisiana Crawfish Farmers Association boiled one ton of crawfish. That is a lot of crawfish and European participants had a double-take at the sight of whole sacks of boiled crawfish being dumped on tables.

Lindqvist said that he got weak in the knees at the sight. Karlsson told me that he felt like he had died and gone to heaven. One lady from Austria put the whole crawfish in her mouth, shell and all. In Europe a good crawfish feast is about six crawfish per person. A lot of time is spent, almost ceremonial, in eating them. The meat is removed from the first claw with a five-inch long knife that has a blunt hook on the end. This tool, with a red handle, is specially made just for this purpose. After eating the meat from the first claw and sucking out the juices, a glass of aquavit is consumed. This is a dry Scandinavian liquor-flavored drink with caraway seeds. The meat is removed from the second claw, followed by another glass of aquavit. The tail is removed next and the juices are sucked out of the body cavity. Another glass of aquavit is taken. And at last the tail meat is consumed, followed by aquavit. Now you can see why only six crawfish is about all anyone would want.

A wine company donated bottles of Blue Nun wine that filled an iced-down pirogue. Ms. Myrtle Anderson, Louisiana Cooperative Extension Service, devoted nearly full time to the symposium. She set up a ladies tour and made participants feel welcome with her many gifts and surprises. She was honored at the crawfish boil with a plaque for her contributions toward the symposium. Sally Kuzenski, with the Louisiana Sea Grant Program, was responsible for entertainment: crawfish race, Cajun band of Ed and Bee Deshotels and many other

Former grad student Jay Huner with grass carp. The fish is native to Russia and China. A leader in crawfish research, he became director of the Crawfish Research Center at the University of Southwestern Louisiana, and he served as secretary of the International Association of Astacology for many years.

activities. Jay Huner and Larry de la Bretonne, graduate students of the school, set up displays in the coliseum and at Ben Hur Farm. Gov. Edwin Edwards sent a welcome word to our group and invited us to the capitol for coffee and tea. The following also gave of their time and/or resources: Wade Martin, Louisiana Secretary of State; Dave Pierce, Louisiana Secretary of Agriculture; Joe Herring, Kenneth Smith, and Burt Angelle, Louisiana Department of Wildlife and Fisheries; Leslie Glasgow, assist. director of our School; John Cox, Ph.D. director of the LCES; John Thibault, president of the Louisiana Crawfish Farmers Association; and Martin Wooden, PhD., president of the LSU system. Wooden served as judge for the crawfish race. Debbie Robert, Miss Louisiana, handed out door prizes. Bob McCracken assisted in obtaining financial help.

Burton Angelle was a former secretary of the LDWF. Our School developed a solid relationship with him. We interacted in so many ways, such as attending scientific meetings together and in sharing information on fisheries management. (Photo by the LDWF)

The crawfish race was of particular interest to those in attendance. Such races had been held for a number of years at the Breaux Bridge crawfish festival. We followed their rules in running the race. The winner of the race was Clovis (Klo-vees), a crawfish handled by Stellen Karlsson. Clovis was invited to participate in the upcoming race in Breaux Bridge. She began immediate training, because we knew this would be the race of her life. She was to go against some real competition, such as Pugh Yi, Beauregard, Alfonse and other well-known male crawfish. These crawfish may have seemed intimidating, but not to Clovis. Their big claws slowed them down and Clovis, a trim female, out-crawled them. She won the race. It hit national news, and Heywood Hale Broun interviewed us about her victory.

It was announced by Ossi Lindqvist at the 1974 symposium that Intercraysymp III would be held in Kuopio, Finland August of 1976. In 1990 the symposium came back to LSU. de la Bretonne and Romaire coordinated this symposium. Huner has held all elected positions in the IAA and served as the General Manager of the IAA's Permanent Home Secretariat (office) since the latter half of the 1980s until 2004.

World Aquaculture Society

A meeting was held at Grand Terre Island, La. in January 1969. The purpose of this meeting was to coordinate mariculture activities among gulf states. The Louisiana Department of Wildlife and Fisheries and the LL&E served as hosts. An invitation list was compiled, including those persons in the Gulf and South Atlantic areas with an interest in mariculture. More than 50 people attended the two-day meeting, where informal discussions were held. Mostly, people stood up in the audience and told what they were doing in the field (mariculture). It was suggested by one "we keep things shirt-sleeve simple." Another said "let's not get too structured." At this meeting it was agreed we should get together again.

Gordon Gunter offered the facilities of the Gulf Coast Research Laboratory in Ocean Springs, Miss. A meeting was set for Sept. 9, 1969. Gunter distributed an invitation to all individuals on the mailing list and others with an interest in mariculture. At the meeting it was agreed by all that some sort of organization should be formed. Gunter said "there are enough international societies around; we'll call ourselves the World Mariculture Society (WMS)." This was a statement, and not just a motion to discuss. Everyone present nodded in agreement. There was no need for a hand vote. Two things are of note here: First, we suddenly went from a Gulf Coast group to a world group. Second, the word mariculture, not aquaculture, was in the name of the newly formed society. Many in attendance worked in the marine area, being mostly from Gulf Coast states. Further, there was a growing interest in pompano and shrimp farming. And E.S. Iverson wrote the book "Farming the Edge of the Sea." During this meeting G. Robert Lunz was elected honorary life member and honorary president. Frank Ritchie of LL&E was voted honorary life member.

Avault and a counterpart from Texas A&M were selected to determine a time and place for our first workshop as a new society. The word workshop was used instead of meeting because certain federal workers could get approval more easily to attend workshops. LSU was chosen to host the first workshop Feb. 9-10, 1970. Ted Ford, Ph.D. previously with the Louisiana Department of Wildlife and Fisheries and now with LSU Sea Grant, lined up the speakers for the program, and Avault lined up housing, special meals, banquet, post conference tours, and related matters. The workshop and housing, were in Pleasant Hall on the LSU campus. This facility houses the Division of Continuing Education (Division). The building itself is set up to hold such gatherings as ours. Sam Britt, Ph.D. of the Division and others provided help with the many needs in hosting such an event.

Paul Bente, president of Marifarms Inc., gave the keynote address. He focused on the potential of mariculture, with emphasis on shrimp farming. Here are a few points he made: "The natural supply of shrimp is decreasing, forcing shrimpers farther afield. As the natural catch of shrimp dwindles, cultivated shrimp will be able to augment the supply. America's shrimpers have

been unable to meet this country's demands for more than 15 years. Imports of shrimp have largely filled the increase in U.S. demand."

Papers were presented by both research scientists and by the private sector. It was good to see such involvement from the private sector, as was also the case at the Grand-Terre meeting. Three papers were presented on oysters, three on mariculture law, one on shrimp, one on pompano, one on cage culture of channel catfish in heated effluents, three on feeds and nutrition, three on fish health, two on larval culture, and one on striped bass. From a species standpoint, papers on shrimp, pompano, and oysters contributed much to the program. The papers, edited by Avault, graduate student Jaspers, and Edmond Boudreaux of the LSU Division of Continuing Education, were published. Sally Courtney of the Division designed the logo for the book.

The proceedings included the history of the WMS up to and including the current workshop. Appended was a list of participants under headings of student membership, regular membership, institutional membership, and honorary-life membership. For the next 16 years the proceedings served as a depository for the archives. All papers presented at annual meetings were peer reviewed and considered for inclusion in the proceedings. A number of papers were by fish farmers and similar participants. Though some studies were not set up to draw statistical conclusions, these papers, with a kernel of new information, were sometimes reduced to a short note. Avault continued to serve as editor for 16 years, at which time the format of the annual proceedings changed to a quarterly scientific journal which considered papers for publication at any time. No longer were papers given at an annual meeting automatically considered for publication.

During the business meeting in Pleasant Hall, Ted Ford was elected president and Avault secretary-treasurer. In later years, the latter position was split into two offices - treasurer and secretary. Avault was elected president in 1975.

The Division served as an interim home office of the W.M.S. LSU provided free secretarial help, office space, phone services, and other needs to run an office. Some years later two officers of the W.M.S. came to LSU and the Division to officially make LSU the permanent home office. It was suggested by us that yes we would like to continue as home office, but we felt that other groups should have an opportunity to put in a bid. This went out in a newsletter. In the end LSU became the permanent home office. However, we could not impose on the Division any longer for office space and services. Chancellor H. Rouse Caffey made space available for the home office plus storage space in John Parker Coliseum, and the home office is still here.

The W.M.S. had begun with a solid foundation. A home office was in place. The proceedings were published in an orderly manner. To further strengthen this foundation, it was felt that annual meetings should be held in the United States for about three years in a row than outside the country the next year. Our first meeting outside the USA was held in Mexico. Over time, meetings were held more in other countries, as it should be. As the W.M.S. (eventually renamed World Aquaculture Society in 1987) continued to grow, affiliates, representing regions throughout the world, became part of the society. At one point membership reached 4,000 representing 86 countries.

Graduate Students

Graduate students perform much of the research in fisheries and aquaculture while working toward a M.S. or Ph.D. degree. Each M.S. thesis completed, and each Ph.D. dissertation completed, adds a building block toward our knowledge of natural fisheries and aquaculture. This knowledge benefits all. Some graduating students become research associates and continue research in concert with their major professor (i.e. research and academic advisor to the student).

Students have a committee to guide them along. This consists of a major professor and two or three other faculty members. We often have committee members outside of the disipline. For example, faculty from entomology, wildlife, and forestry have served on our student's committees. We may have someone from the Department of Experimental Statistics. The value of this is that the research design is set up properly, allowing statistical conclusions. Once a topic of research is selected a committee is formed. The student is then offered suggestions by his or her major professor regarding potential committee members. At some point a research proposal is written by the student, reviewed by the major professor, and then given to each committee member for review. Following this a meeting is held by all to discuss the proposal.

From 1962 until 2008 a total of 287 graduate degrees in fisheries/aquaculture and related areas were awarded. Of these 281 were from our School. Four were from marine science, one from entomology, and one from zoology.

Research

Following are a few examples of research from our School. No attempt will be made to cover all research. For our purposes we will arbitrarily lump the categories as follows: crawfish, catfish, polyculture, bullfrogs, Atchafalaya River Basin, and scenic rivers. There are others.

Crawfish

Shortly after I came to LSU, Leslie Glasgow invited me to go with him to a hunting club function. After the meal Glasgow was asked to say a few words. When he finished his remarks, someone in the crowd asked him about the new guy with him. I was then asked to say a few words about "what do you plan to do at LSU." I said that I was interested in doing crawfish farming research. That got a lot of laughs. Someone in the audience hollered out, "You don't have to grow them. In the spring you can pick them up off the highway." Maybe so, but this free meal depends on Mother Nature. Basically this: In the Atchafalaya Basin you need a dry summer to encourage crawfish to burrow and to control fish predators. The dry summer also encourages the growth of vegetation. You need a wet fall to bring crawfish out of their burrows, the females releasing their young. There should be enough water to flush the Basin. A mild winter allows crawfish to grow rapidly. All of this depends on Mother Nature. Farming crawfish allows one to control all of these factors except the mild winter.

In 1966 our first crawfish study was conducted in 84 vinyl-lined pools. Pools were stocked at two rates with young crawfish. Various treatments included combinations of feeding, fertilization, and soil or no soil. Much was learned. Perhaps the most significant finding was that in pools with no soil, regardless of any other factor, crawfish were very soft, as if they had just molted. A check of water quality revealed that water in pools without soil was very soft, less than 17 ppm total-water hardness. Crawfish did not survive below this level. The water used in the study came from the deep well across from Ben Hur Road.

This led to the next study by graduate student de la Bretonne. The total-water hardness was adjusted in pools, with various concentrations ranging from 15 ppm to 200 ppm. Crawfish grew best in water at 100 ppm, significantly more than at any other concentration. At 200 ppm total-water hardness there was no increase in growth over that of 100 ppm. This information was a direct benefit to farmers who could increase low total-water hardness in their ponds with agricultural lime.

Some people were interested in growing crawfish in brackish water. Could they? Crawfish had been produced in brackish water at Pecan Island in Cameron Parish. We had to provide answers. Grad student Harold Loyacano conducted a lab test with crawfish tolerance to salinity and found: Newly hatched young were killed in less than one week in salinities of 15 ppt; juveniles died at 30 ppt in 2 to 3 days; adults showed no significant mortality in salinities up to 30 ppt after one week. His next study showed that salinity affected growth. As salinity increased, growth decreased.

Meanwhile Guthrie Perry, former graduate student from our School, conducted an experiment in a 6-acre pond at Rockefeller Wildlife Refuge. Salinity was 8 ppt when 89 pounds of adult crawfish were stocked per acre. The salinity later dropped to 4 ppt. Crawfish were not trapped the first season to allow the population to build up. The second year production of crawfish was about 272 pounds per acre. Perry raised the question that the salinity may adversely affect growth and reproduction. The overall conclusion is yes you may get some production of crawfish in brackish water, but probably not enough for commercial purposes.

Questions were raised about crawfish when they are in their burrows. Do they need water in the burrows to survive? Will they reproduce without standing water in the burrows? What about water quality in borrows? Graduate student Mony Jaspers answered some of these questions. She examined more than 150 burrows by digging them up. A total of 33 percent of burrows had no water, only wet clay. Those with water had dissolved oxygen as low as 0.2 ppm. A total of 41 percent of burrows had mud plugs, the rest chimneys. Survival of crawfish was good under all conditions, even in those burrows with no standing water. As long as they keep their gills moist, they can survive by using oxygen in the air. They are able to do this with the high humidity in burrows. The mud plugs assist in this need. Graduate student Murat Gonul added to this knowledge of burrowing crawfish with further studies in ponds three decades later.

Graduate student Earl Melancon determined the tolerance of crawfish to low dissolved oxygen. For 1-inch crawfish the 96-hr LC 50 was 0.5 ppm. This means that within 96 hours half of the crawfish died at this concentration. For 0.5-inches crawfish it was 1 ppm. This information does not contradict the results of Jasper's study. In Melancon's study the crawfish could not climb up the slick sides of the jar to reach atmospheric air for oxygen.

Ray McClain, of the Rice Research Station, added important information regarding the ability of crawfish to survive and reproduce under different conditions of water availability in burrows. Some said, before this study, that crawfish had to have standing water in the burrows for glair to cure. Glair is the glue that holds the eggs to the female's tail. Still others said that there would be no reproduction without standing water in borrows. To simplify McClain's study, he put soil into 72 separate sections of PVC pipe. Crawfish were added to the pipes, and they burrowed. The bottoms of 36 pipes were in standing water. The other half were not in standing water. Water was added to half the pipes at a rate of 1-inch per week and half the pipes received water at 0.1-inch per week. This translates to a rate of 52 inches per year and 5.2 inches per year respectively. In essence, there was no significance difference in survival or reproduction among the treatments. The 5.2 inches

used in this study is far below what actually happens in nature. For example, with three drought years in the crawfish growing area of South Louisiana we find: in 1990, 40 inches per year; in 1999, 49 inches per year; and in 2000, 40 inches per year.

In 1999 Mr. Benoit, a crawfish farmer and processor from Gueydan, was visited. He showed us a field that had been dry for well over a year. The field was then flooded in order to water- level the land. Crawfish popped up all over, as was shown on a video taken earlier.

From all of these studies and observations, it was demonstrated that crawfish can, indeed, adapt to harsh conditions in borrows. However, a farmer should strive for optimum conditions when growing crawfish. With a dependable water supply, and good management, optimum conditions can be maintained. This allows us to produce predictable crops year after year, rather than the hit or miss as found in the Atchafalaya Basin. Moreover, markets can be established.

We learned from one of our earlier studies that crawfish feed well on pelleted diets, but the cost was not favorable. We began a search for a feedstuff that would grow crawfish well, was readily available, and was favorable in cost. Crawfish can be classified as herbivores (eat vegetation), detritivores (eat decomposing organic matter), and omnivores (eat both plant and animal matter). They are also carnivores (eat animal matter). In other words, they will eat most anything. But what is the best?

Graduate students approached this from a number of ways. Don Clark set up a study in a controlled environment. Crawfish were grown in pools with fertilization, planted vegetation, and feed. Jon Goyert tested various agricultural byproducts such as sweet potato vines and trimmings. Robert Romaire stocked crawfish in ponds that had treatments of fertilization, and two agricultural forages as supplemental feed. Bob Rhodes grew crawfish with two rice varieties, two levels of nitrogen fertilizer, and two crawfish stocking rates. As an aside, he also developed the "burrow blaster". Ricardo Rivas used poultry manure and sugarcane byproducts to grow crawfish. Barnes Johnson tested poultry wastes, rice, and delta duck potato. Mike Miltner evaluated rice and Japanese millet as food substrate for crawfish. Carlos Garces compared various volunteer vegetation, such as alligatorweed, with rice. Erik Villagran studied the effects of stocking density, forage availability, and supplemental feeding in pools. Karim Belhadjali studied the effects of supplemental feeding in ponds. And a number of other feedstuffs were evaluated such as range cubes. Range cubes are made from compressed hay, ceral grains and binders which are formed into cubes. They have been used to feed cattle and horses. At the Rice Research Station, Ray McClain evaluated sorghum-sudangrass.

Rice plants met all of the requirements for a good feedstuff. Crawfish grew well on decaying rice plants, rice seed is readily available, and is reasonable in cost. Rice provides a predictable source of food, compared with natural vegetation such as alligatorweed. Further, rice has a favorable carbon:nitrogen ratio. This means that it decomposes at a steady rate. On the other hand, certain agricultural wastes, such as for sugarcane, have a C:N ratio higher than 100. It takes much longer to decompose.

Decomposing organic matter becomes nutritious when the C:N ratio gets below 17. At this level decaying rice stubble is coated with bacteria and other microorganisms. Crawfish glean these microorganisms, called periphyton or aufwuchs, from decaying plant material. In addition numerous animals besides crawfish rely on the microbe-rich detritus. Mollusks, insects, worms, small crustaceans, and some small vertebrates depend on detritus. These animals in turn enrich the diet of crawfish.

Rotating rice and crawfish is a natural. Rice farming provides a dependable supply of water, rice stubble as a food source for crawfish, labor already on hand, and the ability to spread overhead costs over two crops instead of one. Graduate student Yew-Hu Chien studied the rotation of rice and crawfish. At first the process went basically like this: Rice is seeded in March. Crawfish are stocked into rice fields in June at a rate of 40 to 80 pounds per acre; crawfish burrow. Water is drained in August for rice harvest. Around mid-October water is flooded back onto the field. Female crawfish emerge from burrows and release young that are attached to their tail. Crawfish harvest can begin in late November or early next year. The peak of crawfish harvest begins around March, and this is when prices are best because of the lenten season. However crawfish harvest must stop so that rice can be planted again in March.

Farmers were reluctant to use this rotation. They were making good money farming rice. Why bother buying traps and bait, worrying about theft, interference with their hunting, and so on. Then in 1982 it happened. The price farmers received for rice was below break-even. Some farmers thought that it was time to try the rice and crawfish rotation. Now the farmers themselves adjusted the rotational system. Here is how: Rice is seeded in March. Crawfish are stocked in June, and they burrow as before. The field is drained in August and rice is harvested. The field is flooded in mid-October as before. Crawfish are harvested as before. Now instead of stopping crawfish harvest in March and going back to rice, crawfish harvesting continues to about June 1. Rice is late planted. Or the land lays fallow from June 1 until March of the following year at which time rice is planted. Graduate student Chris Day took it one step further by adding soybean production into the mix. The significance of all this research is that it gives farmers options instead of monoculture of rice. Depending on

market prices and other factors, they can adjust their farming strategy. The rice and crawfish rotation is now the mainstay of the industry. In 2013, for example, of the 185,000 acres in crawfish production, 60 percent to 70 percent were estimated to be in rice and crawfish rotation.

Pesticides are used to grow rice. How do they affect crawfish? While we were working out methods for rotating rice and crawfish, graduate students also studied the effects of pesticides on crawfish. Algie Jolly determined the toxicity of the insecticide Pounce on crawfish in lab studies. Cheah Ming-Long did likewise with 13 rice pesticides used in rice farming. Sunday Ekanem furthered our knowledge on the subject. Dwayne Coulon determined the toxicity of Ambush and Pydrin to crawfish and to channel catfish. Herman Jarboe studied the toxicity of permethrin to crawfish and the effects on feeding crawfish. Ronald Brown determined the toxicity of antimycin and rotenone to crawfish in ponds.

Here are generalizations from these studies: Virtually all insecticides are toxic to crawfish. Malathion was the least toxic, but some like pyrethroids are highly toxic in concentrations lower than 1 ppb. Furadan is an insecticide that had been used for years to control the rice water weevil. It is toxic to crawfish in concentrations of 0.5 ppm. When Furadan was used, crawfish could be safely stocked three weeks later. Around 1999 Furadan was taken off the market by the EPA for environmental reasons. Herbicides are generally safe to use with crawfish in ponds, as are fungicides such as Benlate. Armed with this information on pesticides, farmers can intelligently apply them when growing rice and crawfish together.

Harvesting crawfish is a major expense, involving bait, traps, harvesting equipment, and labor. Crawfish trappers relied mostly on gizzard shad or menhaden for bait. Crawfish bait is the single largest expense, and accounts for nearly one-third of production costs. Pillow traps were used; these are traps that have two funnels, are shaped like a pillow, and lay on the bottom.

We turned our attention to developing a formulated bait around 1979. Graduate students conducted a series of studies. Jose Collazo evaluated several experimental baits. Baits were a mixture of cereal grains and an attractant. This mixture was placed in Bull Durham sacks and tested for catching crawfish. Bill Pollock took the next step by making a pellet. This required a binder, such as wheat gluten, to hold the pellet together. He used a rented concrete mixer in the process. Carol Burns continued the research. Cevallos Osorio studied attractants for formulated baits. Lance Beecher evaluated harvesting strategies involving bait type and quantity.

By 1985, we had an effective formulated bait. We went to then Chancellor A. C. Harper and told him that we would like to get a patent on the bait; any royalties would come to the Louisiana Agricultural Experiment Station in support of our research. At that time the AgCenter did not have a policy to pursue patents. In the end the state legislature got involved. The outcome was that a volunteer fee or "checkoff" would be collected on formulated baits sold. The money would be used for promotion and research of crawfish.

Meanwhile other research continued. Graduate student Marco Leal Araujo studied the effects of water quality, climate and lunar phase on catch of crawfish. Jimmy Avery evaluated sampling gear for predicting harvest size, yield and incidence of stunting in crawfish ponds. Various trap designs were evaluated. Tammy Baum evaluated hoop-net traps for catching crawfish. In the end the 3-funnel pyramid trap became the design of choice.

Graduate student Dean Cain experimented with a novel way for catching crawfish, using electricity. (In Taiwan electricity is used to harvest shrimp from small ponds. The operator walks through the pond with the electro-trawl. A car battery on floating styrofoam is pushed ahead of him.) On the front of a boat Cain mounted an electro-trawl with a pulsed direct current field. As the boat moved through the water, an electric current caused crawfish to jump up and get caught in the trawl. This method caught a lot of crawfish the first day it was tested. Only one thing, most were soft-shelled crawfish. Crawfish about to molt will not go into traps; if they molt they will be eaten by other crawfish. We took this catch of soft-shelled crawfish to Mike Anderson's new restaurant. It was in a former grocery store just outside the south gates of LSU. We asked, do you have soft-shelled crabs on the menu? He did. It was suggested that he try soft-shelled crawfish by adding one or two to a seafood plater.

Dudley Culley of our School and Ron Malone, Ph.D. of Civil Engineering took production of soft- shelled crawfish to the next level. They developed a system of water-flow runways. When crawfish molted they could not hold on against the water flow, and were carried to a collecting area. Former graduate student Rex Caffey developed a similar procedure at a commercial farm. Huner was interested in production of soft-shelled crawfish for use as fish bait. Huner later became director of the Crawfish Research Center at the University of Southwestern Louisiana. His research addressed many needs of the crawfish industry.

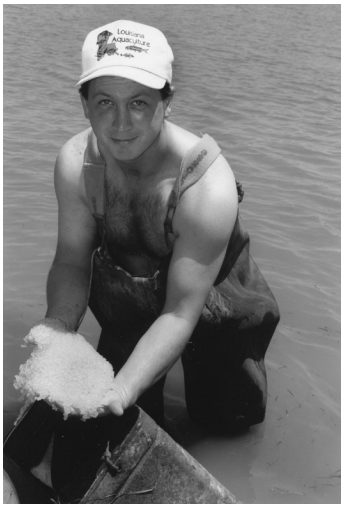
During the early years of our research we strove to produce as many pounds of crawfish per acre as possible. Trapping strategies reflected this; for example, traps were run daily. Then we paid attention to the farmer's bottom line, net profit. This entailed, for example, the number of traps set per acre, and the frequency of running traps. Further, at some point crawfish were graded to size, larger crawfish bringing a higher price. This

was brought about by two events. First, the European market opened up. They wanted a large crawfish boiled a certain way. Southeast Texas began crawfish farming, and they graded to size. Now we turned our attention to the production of large crawfish. Simply put, having excellent water quality and unlimited food did not produce large crawfish. It had to do with density. At low densities crawfish grew large.

The best way to get the whole picture of crawfish farming is through the excellent publication titled "Louisiana Crawfish Production Manual." It was published in 2007. The authors are W. Ray McClain, Robert Romaire, C. Greg Lutz, and Mark Shirley. Contributors included Jimmy Avery and Wendell Lorio.

Catfish

Catfish farming has come a long way since the mid 1960's. Stocking rates of catfish fingerlings started at around 1,500 per acre, climbed to 2,000, and eventually reached 3,000 fingerlings per acre and beyond. Other changes took place. At the 1,500 stocking rate, fish were fed a supplemental feed; they were expected to get some nutrition from pond organisms. As the stocking rate climbed, vitamin deficiency became a problem. The broken-back syndrome became prevalent because of vitamin C deficiency. To overcome this and other related vitamin problems, farmers switched from a supplemental feed to a complete feed. The next problem with the ever higher stocking rates was poor water quality, particularly low dissolved oxygen. To combat this problem farmers used emergency aeration. This was accomplished with an aerator churning the water from the power-take-off of a tractor. Once the fish were put down, aeration stopped. Graduate student Robert Durborow studied the mortality of full-sib channel catfish families at low levels of dissolved oxygen.



Former grad student Ken Rust removes channel catfish eggs from a spawning container. He now works in the private sector and sells aeration equipment and related equipment needs.

Around 1978 we began to look at permanent aeration, that is it ran all the time. Graduate student Bryan Plemmons stocked 12,000 catfish fingerlings per acre in ponds, fed at a rate to promote growth, and ran a vertical pump aerator 24 hours a day in ponds. Production was 6 tons of catfish per acre. The cost of electricity amounted to 5 cents for each pound of catfish produced. Water quality was good, with oxygen levels uniform from top to bottom. In Taiwan, paddlewheel aerators are used to grow shrimp. Today, the use of aerators are the norm for growing catfish and other species. Use of aeration was advanced by Claude Boyd, Ph.D. of Auburn University and others.

Fish farmers are always looking for the perfect fish to grow and catfish farmers are no exception. In the 1930's and 1940's H.S. Swingle, Ph.D. of Auburn began to look for the best fish to farm. He field-tested channel catfish, various bullheads, and many others. Graduate student Marion Burnside compared a wild and domestic strain of channel catfish. The channel catfish has emerged as one of the best warmwater fishes to grow. O.L Green, from the federal lab in Marion, Ala., and others, produced 28 different hybrid catfish. Of these the female channel catfish crossed with the male blue catfish has produced the best hybrid. The channel catfish is hardy, easy to handle, and can be grown under a variety of conditions.

On the negative side, the channel catfish is difficult to seine, does not grow uniformly, and is prone to the channel catfish virus disease (CCVD) and to enteric septicemia of catfish (ESC). The blue catfish is resistant to CCVD and ESC, grows uniformly in size, has a high dress-out percentage, will feed in cooler waters than the channel catfish, and is easy to seine. On the negative side, it is not easy to handle and is prone to other diseases. The hybrid between the two species appears to combine most of the good traits of both parents without the negative traits.

Earlier we said how Terry Tiersch developed a program to preserve fish sperm. Graduate student W. Clell Guest added to our knowledge of sperm preservation, as did Joseph Christensen, Gregory Roppolo, and Carmen Paniagua-Chavez. Qiaoxiang Dong studied sperm preservation of diploid and tetraploid Pacific oysters. Christopher Whaley successfully hybridized sunfishes via cryopreservation. E. Hu conducted research to develop production of catfish hybrids for commercial purposes. More than 1 million channel catfish eggs from 300 females were fertilized with thawed sperm from blue catfish. This success is only a step away from going commercial. There is another reason for sperm preservation, and that is to preserve sperm of endangered species, as mentioned earlier.

Channel catfish when 3 years old are capable of spawning when the water temperature reaches 70 F. They spawn once a year. Graduate students Patrice Pawiroedjo and Robert Lang were able to get early out-of-season spawning of channel catfish by manipulating water temperature.

We conducted cooperative research with Guthrie Perry at Rockefeller Wildlife Refuge. Prior to this research, he determined the relative abundance of blue and

channel catfish in natural waters with relation to salinity. Our cooperative research focused for eight years on growing freshwater channel, blue, and white catfish in brackish-water ponds. Catfish not only tolerated salinities up to 8 ppt, they thrived in brackish water. They could not, however, reproduce in salinities above 2 ppt. Graduate student Clifford O'Neal studied the effects of low-level salinity on production of fingerling catfish. Graduate student Kenneth Allen studied the effects of salinity on growth and survival of channel catfish, eggs through yearlings. Among other things we also learned that the dreaded protozoan that causes white-spot disease could be controlled when catfish are held in salinities of 1 ppt for one week. Growing fish in brackish-water ponds appears to offer built-in protection against brown blood disease. Off-flavor of fish flesh was never a problem.

Former grad student Mark Lamon demonstrates to class how to handle channel catfish eggs. He now has a managerial position with a company that is the world leader in production of Artemia, a small crustacean used to feed larval shrimp.

Polyculture of Fish and Crustaceans

Earlier we discussed double-cropping (rotating) of rice and crawfish. Polyculture involves culturing two or more species together with the goal of maximizing production and profit. By stocking species with differing food habits, natural food niches in a pond can best be used. Graduate students conducted polyculture with a number of fish and crustacean species. Here are a few examples: James Tuten grew together crawfish, channel catfish, bigmouth buffalo, and paddlefish. Catfish were grown in floating cages to prevent predation on crawfish. Each species occupied a different food niche in the pond. Lee Green grew caged channel catfish, a buffalo hybrid, golden shiner, and crawfish together. Steve Gabel grew channel catfish and tilapia together. Andrew Merkowsky grew channel catfish and hybrid grass carp together. Mark Lamon, Alberto Granados, and G. Craig Lilystrom grew channel catfish and malaysian prawns together. You might think that catfish would eat the prawns, but they didn't. In one study survival of prawns from 18 ponds exceeded 95 percent. Prawns reached a size of 5 to 6 to the pound.

Steve Cange added a new dimension to prawn culture. He successfully grew prawns in brackish-water at four stocking densities and in freshwater ponds with rice or supplemental feed. He designed and built our prawn hatchery at Ben Hur Farm.

Prawn hatchery designed and built by former grad student Steve Cange. He contributed greatly to the knowledge of the giant Malaysian prawn. He presented his findings at an international aquaculture conference.

Bullfrog Research

Growing bullfrogs is not easy. One of the first lessons learned is that they required live food that moves. Most of the frogs served in restaurants are wild, imported from other countries. Dudley Culley took on the task of growing bullfrogs in captivity. Graduate students conducted a series of experiments: Claude Gravois studied the growth of bullfrogs under crowded conditions. Albert Doucette developed foods for larvae of the bullfrog. Craig Smith studied the reproductive development of female bullfrogs. Kirk Easley researched the effects of hormones and environmental factors on male bullfrogs. David Marschall developed feed formulations for bullfrogs. Mohd Othman researched the reproductive conditions of female bullfrogs. Gail Marshall determined the effect of certain water quality parameters on bullfrogs. Thomas Graham studied the effect of a bacterium on bullfrogs. Randall Montegut studied effects of photoperiod and temperature on reproductive development of male bullfrogs. Joseph Penkala studied the

Robert Barham, a former state senator, now serves as secretary of the LDWF. His exemplary leadership has put Louisiana's Wildlife and Fisheries program at the forefront. The LDWF continues to have strong interaction with our School. (Photo by the LDWF)

ovarian cycle in bullfrogs. At some point, Culley changed his focus from producing bullfrogs for food to producing bullfrogs as lab animals, much like the white rat. The research effort of Culley and students laid a solid foundation for research yet to come by others.

Aquatic Species Studied

Since 1959 a variety of aquatic species have been studied. We listed some of them earlier. Here is a partial list of others in no particular order; some may have already been treated above: pompano, striped mullet, red drum, red snapper, shrimp, oysters, croaker, brine shrimp, striped bass and its hybrid, blue crab, crappies, bluegill, bowfin, koi carp, buffalo fish, grass carp, red claw crawfish, alligators, largemouth bass, warmouth, orangespotted sunfish, tilapia, freshwater drum, carpsucker, snapping turtle, and spotted bass.

Scenic Rivers Study

Our state is blessed with many beautiful streams. Gladney Davidson took on research that brought this to the forefront. His thesis study was streams and stream preservation: justification for a scenic rivers program in Louisiana. He studied many streams throughout the state, suggested guidelines for official designation, and set the template for future studies. Following graduation, he began work for the Louisiana Department of Wildlife and Fisheries where he continued research with streams.

Research in the Atchafalaya River Basin

The Atchafalaya River Basin (Basin) is truly unique. There is nothing like it in North America. It is approximately 17 miles wide and 100 miles long. The Atchafalaya River began to capture the flow of the Mississippi River around 1550, and left unchanged had the potential to collect the full flow of the Mississippi. Around 1945 the Atchafalaya captured the full flow of the Red River. By 1950 the Atchafalaya was receiving 30% of the flow from the Mississippi River. It was deemed that this level should be maintained. Therefore two river control structures were built to maintain this flow. The Basin supports commercial crawfish trapping, sportfishing, ecology functions, boat tours, photography, and many other functions.

Personnel of the Louisiana Cooperative Fisheries Unit have played, and are playing, an important role in adding to the knowledge of the Basin. Fred Bryan, William Kelso, Allen Rutherford, along with graduate students and colleagues, have spent a lifetime of research in the Basin. What follows is only a small sample of what they have learned: Tim O'Brien studied the crawfishes of the Basin with special attention given to those species of commercial importance. Important, indeed, beginning in 1978 records were kept on the crawfish catch from the Basin. That year 26.5 million pounds were trapped (LA Ag Summary.) In 1993 and 1994 69 million pounds and 68 million pounds, respectively, were caught. Since then the catch has slowly trended downward.

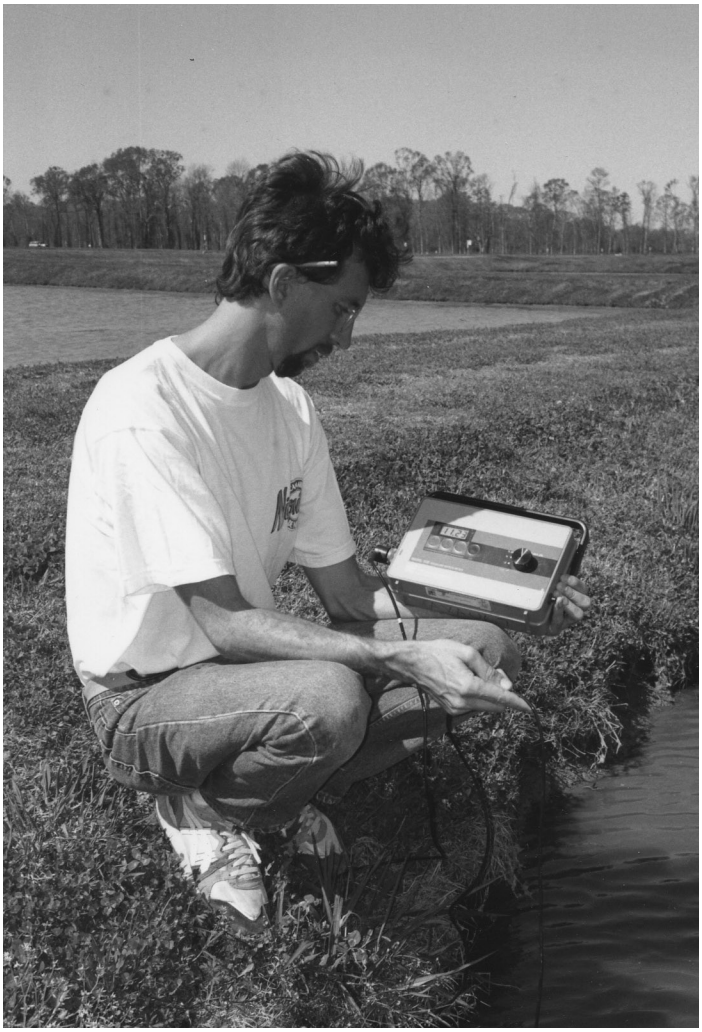
David Dugas studied the benthic macroinvertebrates of the River. These organisms play an important role in the food chain of many aquatic species. Randy Landry studied parasites of young-of-the-year largemouth bass, an important sport fish. Gregg Snedden studied the spotted gar in the lower Basin. John Troutman researched the importance of water quality and fish food organisms to juvenile fishes. Mark Gannon studied the growth and distribution of larval fishes in the river. David Hickman determined the effect of low dissolved oxygen on largemouth bass from the river. Jeffrey Corbino studied phytoplankton. Phytoplankton is the first link in the food chain. Torrance Mason determined the effect of the aquatic weed hydrilla, and drawdown, on the food habits and growth of young largemouth bass. Jose Colon-Gaud researched the effect of two species of vegetation on macroinvertebrates. M.D. Kaller et al. studied the effect of decomposition of organic matter and water flow on low dissolved oxygen. Christopher Bonvillain conducted a study on factors that produce hypoxic stress in crawfish.

Jay Huner, a former graduate student from our School, and Mark Konikoff of USL developed a wild-caught management plan for the Basin, focusing on crawfish. The Louisiana Crawfish Promotion and Research Board sponsored the study. The study proposed guidelines for a management plan of wild-caught crawfish in the State of Louisiana, with emphasis on the Atchafalaya Basin fishery.

Foreign Service

Foreign service in aquaculture allows us to improve the lives of people in other countries. Further, it gives us an opportunity to see a variety of aquaculture practices. This broadens our knowledge, which can be shared with students in the classroom. With this approach to teaching, we had graduate students, and visiting professors, from many countries. As only a few examples: China, Taiwan, Germany, El Salvador, Belgium, Nigeria, Canada, Malaysia, and Spain. Once educated, students are prepared to work both here and abroad with a variety of species and culture systems.

Here are a few examples: Edmonde Jaspers returned to Belgium where she played a major role in her countries aquaculture development. Bryan Plemmons farmed rainbow trout in Virginia --there is no trout farming in Louisiana. Yew-Hu Chien played a key role



A former grad student and faculty member of our School, John Hargreaves checks water quality in a pond at Ben Hur Farm. He now serves as an advisor/consultant for Iraq and other countries.

in our research with rice-crawfish rotation. He returned to Keelung, Taiwan where he conducted research with shrimp and other species while teaching at the National Taiwan Ocean University. David Pavel managed a major shrimp hatchery in Ecuador --there is no shrimp farming in Louisiana. Cheah Ming-Long returned to Malaysia where he applied his knowledge learned here as a student. John Hargreaves, Ph.D. has consulted in Iraq and numerous other countries from around the world. On the home front, former students have careers with the Louisiana Department of Wildlife and Fisheries, the USFWS, environmental agencies, other agencies such as the Texas Parks and Wildlife Service, and the private sector.

Many groups and agencies have sponsored aquaculture development in foreign countries: including the US Aid for International Development (USAID), Peace Corps, the Food Agriculture Organization (FAO) of the United Nations, universities, and private-sector groups.

Our service to any country always has a specific goal(s). Most visits are for one to three weeks. To request duty in a foreign country, faculty had to fill out a PM 11 form. This request is approved by the director of our School plus seven others all the way up to the president of the LSU System. Lakshman Velupillai Ph.D., director of the LSU AgCenter's international office, helped with logistics. He is a native of Sri Lanka (Ceylon) and is well versed in handling international assignments. Assisting Velupillai was Margaret Blackwell, who was helpful in so many ways.

Faculty from our School have had service in more than 30 countries representing five continents. Here is a partial list of countries where foreign service was given, in no particular order: Thailand, Austria, Spain, Indonesia, Sudan, Philippines, Sweden, Dominican Republic, Taiwan, Liberia, Honduras, Panama, Guyana, China, Sierra Leone, India, Belize, Nicaragua, Mexico, Jamaica, Germany, Gambia, Nigeria, Equatorial Guinea, Bangladesh, Australia, France, Venezuela, Peru, Chile, Belgium, and Nepal.

Manure, flushed from hog pens to silo (tires on top), produces biogas for domestic use. Effluent waste from the silo then flows into a pond to enrich waters for growing fish. Fish processing wastes are fed to hogs, Tigbauan Iloilo, Philippines.

Philippines

The following account gives a few examples of foreign service in various countries. We start with the Philippines. When you think of the USAID you may visualize sending food and water to nations that have been devastated by a natural disaster. In 1975 H.S. Swingle of Auburn University began an aquaculture project sponsored by the USAID. A Brackishwater Aquaculture Center (BAC) was established at Leganes, Iloilo, and a Freshwater Aquaculture Center (FAC) was established on the campus of Central Luzon State University, Munoz, Nueva Ecija.

A contract was agreed upon by Auburn, the USAID, the Government of the Philippines (GOP), and the local government. The project had two purposes: development of research and extension to expand aquaculture production, and to lower costs by increasing production with existing production systems. Elements

of the project included: construction of research ponds at the FAC and BAC; construction of ancillary buildings such as hatcheries, laboratories, and office buildings; development of trained personnel; research with various aquatic species; and extension to fish farmers. Responsibility for road and bridge maintenance, and other mundane tasks, resided with the local government. Students from the Philippines began graduate studies at Auburn, working toward degrees in aquaculture.

In 1976 Francis Lebeau, consultant, Serapio Bravo, National Economic and Development Authority, and James W. Avault, Jr., LSU AgCenter, evaluated the progress of the project. Here are a few excerpts from our report. Species being cultured at the FAC included: common carp, bangus (milkfish), prawns, dalag, native and Thai hito (catfish), and three species of tilapia. Major research areas included: carp polyculture, rice-fish culture, sex reversal of tilapia, and fertilization and feeding trials with various species. Other research areas included fish pathology and life history studies. Following evaluation of the project, we listed constraints, appraisal, and recommendations. Overall the FAC got high marks; everything was going as planned.

The BAC was evaluated in a like manner. Research was conducted with artificial spawning of milkfish, decreasing mortality of milkfish fry collected in the wild, establishing production ranges of milkfish for lab lab and the plankton method, use of fertilizer platforms, the culture of lab lab, and the study of acid soils. The overall evaluation of the project noted that artificial spawning of milkfish should be held in abeyance. The Southeast Asian Fisheries Development Center (SEAFDC) in the Philippines and the Oceanic Institute in Hawaii had undertaken major efforts here. The road and bridge were in very bad shape. Finally, acid soils on the station posed a major problem. It was noted, however, that a number of farmers we visited also had problems with acid soils. The BAC should focus on this problem.

With other colleagues this author also served as an advisor to the Philippines in 1977, '78, '82, '83, and '87. Some assignments required extensive travel throughout the country; Zamboanga, Mindanao, which was unsafe, was excluded. One assignment involved a sector analysis to evaluate the status, potential, and constraint of fisheries and aquaculture nationwide. The feasibility of establishing a national College of Fisheries was also addressed. The assignment involved interacting with cabinet-level people, such as Secretary Leido of the Department of Natural Resources, as well as with fish farmers and municipal fishermen.

With extensive travel in the Philippines it was possible to see a variety of aquaculture practices. Most family farms are only about one hectare (2.5 acres) in size. The family must therefore squeeze as much production from the land and water as possible. Here are two examples: Tilapia are grown with rice. They occupy shallow trenches parallel to the levees. Gabi grows along the water's edge. Papaya trees and garden vegetables grow on the levee. Pond banks can be planted with ipilipil for firewood. After cutting, the tree puts on new growth and it is later re-harvested.

Animals and fish can complement one another. Hog pens border the pond. Hog wastes are washed down a trough into a silo where biogas is produced. The biogas is used for household purposes. The remaining effluent from the hog wastes flows from the silo into a fish pond to enrich the water. When slaughtered, fish-wastes are fed to the hogs.

Chinese worker brings dirt to a pond levee being built, Guangdong Province coastline of the South China Sea.

People's Republic of China

In June of 1986 Robert Romaire, Larry de la Bretonne, and I traveled to China as advisors on shrimp farming. Like the Philippines, Indonesia, India, and other countries, China was venturing into shrimp farming for foreign exchange. This was the second trip for Romaire and de la Bretonne. Our destination was Zhanjiang in Guangdong Province along the coastline of the South China Sea.

Aquaculture in China is ancient. It is thought by some that when flood-waters receded fish remained stranded in pot holes. The fish could then be captured and eaten when wanted. It was then reasoned that fish could be grown by feeding them table scraps. Following this, fish fry were caught from rivers and deliberately stocked into ponds. The fry caught was a mixture of six different species of carps, commonly referred to as Chinese carps; they were grown together. This was early polyculture, each species with its own food niche in the pond. At some point fish were added to rice fields for added production.

The artificial hatching of fish was practiced in China 2000 BC. The first treatise on culture of common carp (*Cyprinus carpio*) was written by Fan Lai in 475 BC. Early

culture of carp closely followed the manufacture of silk. The silkworm pupae and feces were used to feed fish. Since silkworm culture dates back to 2700 BC in China, one can see the possible antiquity of aquaculture. Methods for growing fish were simple and have not changed for centuries. Following World War II China put forth a major effort in fish production to provide animal protein for its growing population. Then in the 1980's there was a dramatic shift in goals for fish farming. Attention was now turned to growing high-value species, such as shrimp, for foreign exchange.

We saw shrimp ponds. They were built along the coastline of the South China Sea, as far as the eye could see. The ponds were built entirely by hand. By hand means with shovels, a string for outlining levees, and thousands of workers. The workers carried shovels full of dirt in shallow baskets, balanced on their shoulders with a pole and rope. The dirt was dumped on the levee being built. Once deposited the dirt was tamped down with bare feet. Methods for growing shrimp were basically the same as those used for centuries in raising carp in freshwater. Ponds were filled with seawater from the tides. Ponds several rows back from the ocean were not able to receive water and were left dry. Electricity was not available, so aeration of water was not possible. High-quality feed was not available. Shrimp were fed ground-up snails and whatever else could be found. In 1995 Romaire traveled to see shrimp ponds around Shanghai. He found essentially the same situation.

This particular visit by us to China culminated in a ribbon-cutting including firecrackers and dragon dancing. And then as if timed six-packs of beer were ceremonially placed on each table. The beer was used to toast one another. Larry de la Bretonne was targeted. Someone came to our table and toasted de la Bretonne; it was one on one. Romaire and I were not involved in the toasting. After the first one left another came and toasted de la Bretonne, and then another. It was a team effort. This kept up until one of the participants toasting Larry passed out. His superior got all over him. We don't know if it was because of his bad manners or because he let Larry outlast him.

In June of 1995, David H. Picha, Ph.D. of the Horticulture Department and I traveled to China to evaluate the use of geothermal water in East China for aquaculture and horticulture. Our focus was on Hebei and Tianjin Provinces. A Louisiana-based oil company was active in the area. The coastline is often referred to as the Pacific Rim. Commonly found in the oil fields is geothermal water. China was interested in using this water.

This is what we concluded: A variety of aquaculture and horticulture crops can be grown year-round. Further, geothermal water can be used to heat buildings. Tilapia (*Oreochromis niloticus*) is an example of a species of fish that has good potential for culture and market. Water melons and tomatoes are promising crops. Potential domestic markets considered are northern China near Beijing, and southern China near Shanghai. Export markets in Southeast Asia (Japan, Hong Kong, Indonesia, Thailand, and others) are promising. Future markets in Europe and North America have possibilities for certain products.

There are constraints to overcome. There is a weak infrastructure for moving products to major markets, and there is no "quality assurance" or environmental safeguards currently being practiced in the country. Gearing up to produce aquaculture and horticulture products is not perceived as a major problem. Lacking, however, is the tradition of quality assurance in post handling, processing, storage, and distribution. Further there does not seem to be an established marketing channel from producer to processor to broker to retailer. Bottom line: The potential use of geothermal water for aquaculture and horticultural is staggering. Both fish and vegetables can be grown 12 months out of the year. The infrastructure, however, must be developed.

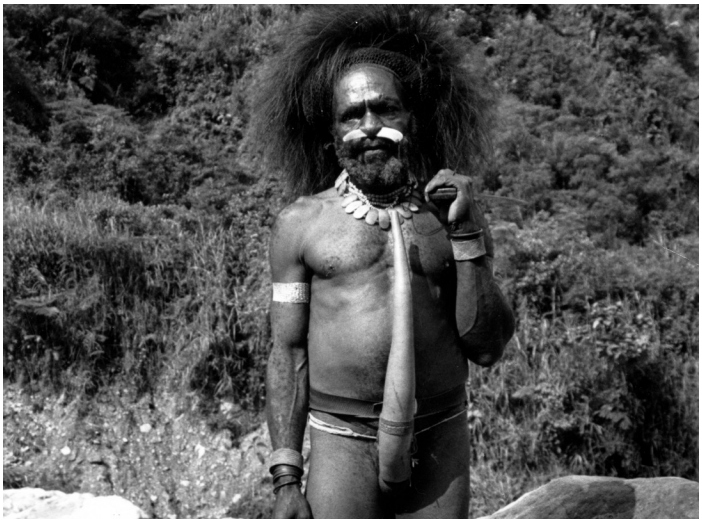
Fish farmer buys fingerling fish that he will stock into his pond. The fish are transported in tarred baskets containing water. Sukabumi, Indonesia.

Indonesia

Indonesia has farmed milkfish for centuries; you could see pond after pond along the coastline of Java. When attention was turned to shrimp farming, suitable milkfish ponds were converted into shrimp ponds. Farm operations changing from milkfish to shrimp, plus first-time operations, lacked knowledge and an infrastructure for growing and marketing shrimp.

Penny Fairchild, a native of Erwinville, La., has lived on and off in Indonesia. She has a penchant for starting new businesses, and this includes shrimp farming. Around 1991 she contacted this author about shrimp farming possibilities in Indonesia. Fast forward several months later. The Merdeka Group near Pangkalpinang, Bangka Island was farming a shrimp called the black

Children of Asmat warriors, Irian Jaya (New Guinea)



Asmat warrior

tiger prawn (*Penaeus monodon*). They needed help. It was all new to them. Back in Louisiana the PMG Consortium was formed: It consisted of Greg Benhard, Jim Winfree, Fairchild, Don Dupuis, Robert Romaire, and this author. Benhard is with his family's Peoples Moss Gin (PMG) in Palmetto, La. The PMG has the capabilities of manufacturing feed and to process and market shrimp. Winfree was an aquaculture consultant. Dupuis was an associate of Fairchild.

After meeting with Merdeka it was agreed that the PMG Consortium would provide feed, an on-the-job manager for feed trials, and a market for the shrimp grown. Romaire and I gave Dupuis a crash-course on shrimp farming, and he traveled to Bangka Island to manage the feed trials. He arrived at the beginning of Ramadan, which meant a small bowl of rice daily for one month. During the study there were several back and forth trips to Bangka Island by members of the PMG Consortium. Overall the PMG feed grew shrimp well, and the feed trial was a success.

On a trip unrelated to Merdeka this author was asked to travel to Sumatra by a company interested in building shrimp ponds at one of two possible locations. The first site was along the coastline; the second was inland in an abandoned rice field. I opted for the rice field. It could no longer be used for rice farming because of brackish-water intrusion. The site along the coastline served as a nursery ground for shrimp. Building ponds here would have a harmful effect on the livelihood of commercial shrimpers.

On another trip, Fairchild and I traveled to Irian Jaya (New Guinea). Freeport of Louisiana has a copper mine at Tembagapura. They wanted our advice on an environmental issue. This land is arguably the most rugged and the most isolated anywhere. The island is enormous and is considered one of the largest in the world. It is found just south of the equator, yet it was cold when we reached the copper mine at the mountain's summit; we were above the clouds.

Irian Jaya is home to a number of head-hunting cannibals, such as the Asmat and Dani; they are just now emerging from the Stone Age. Fairchild and I were invited to visit the Asmat. We crossed a rope foot-bridge to the village; it spanned a deep canyon. We had two interpreters with us. It took two to go from English to the language of the Asmat. When we got across the rope bridge to the other side, several young girls ran to meet us saying "amalo, amalo." We then were allowed to look inside thatched huts. Life of the Asmat is simple. Women grow sweet potatoes, weave net-bags, have children, and raise a pig. The pig is a main source of wealth. It is used to buy a wife and for other special purposes. The men are warriors, formerly head hunters. When Irian Jaya became part of Indonesia the government put a stop to head hunting, as best they could. I bargained with one of the warriors for a koteca; I had a two-bladed pocket knife to trade. I also bargained with his wife for a net-bag. Later, when we were about to leave, the young girls followed us to the rope bridge. I said amalo to them and in so doing I touched one of the girls on the shoulder. This brought about an immediate response from one of the warriors. My first thought was where could I find a pig.

The real purpose of our Freeport visit was to determine if the copper mine was polluting the Timika River. Clean water would help Freeport in its discussions with Greenpeace. One way to determine clean water is to see if fish will grow in it. Fish grown could be used to feed the workers at the mine. The land was far too rugged to divert water to ponds, so it was suggested that fish be grown with floating cages in the Timika. Freeport went one step further in protecting the environment. They had a nursery down below the mountain. When a section of a mountain was no longer mined, plants were used to help recover the land.

Harvesting carp, Andhra Pradesh, India

India

This author and colleague James Winfree travelled to the state of Andhra Pradesh in 1995. Our "terms of reference" called for giving seminars on new species for culture, focusing on high-value species for export. Historically, India has farmed four species of Indian major carps, catfishes, perches, and prawns, mostly for local markets.

We presented 13 seminars to more than 3,000 people in selected areas of Andhra Pradesh. Slides were used in our presentations when electricity was available. The communities visited were: Nellore, Bhimavaram, Tenali, Repalle, Guntur, Vijayawada, Machilipatnam, Gudivada, Kaikalur, Kakinada, Amalapuram, Ganapavavaram, and Eluru.

We listed specific criteria when considering new species for farming. Overall, the Egyptian strain of tilapia (*Oreochromis niloticus*) gave a good fit. The biology is well known, fingerlings are easy to produce, the market for fillets is established, there is no need to make major changes to existing pond facilities, and other criteria were met. Other species with possibilities included: the freshwater prawn (*Macrobrachium rosenbergii*), the catfish (*Clarias betrachus*), and the mud crab (*Scylla serata*). Species were also listed that should not be farmed, such as the channel catfish, and red swamp crawfish.

When an assignment for any country is set in place, the job is clear cut. What is not, however, are things that are not planned; they just happen. In our assignment for India we traveled by jeep through wilderness areas at all hours of the day and night. We slept by dozing off as best we could. At one point the jeep stopped. We had a mechanical problem. The driver said he would walk to the nearest village and get help. The lights stayed on the Jeep. Winfree took this opportunity to relieve himself. He moved off of our so-called road into the bushes. He had just returned to the jeep when a snake started to crawl across the road, about 10 feet in front of us. The lights of the jeep gave us a good look. The head and body of the snake covered the entire width of the road, and then some. He crawled right where Winfree had just been. Later, much later, I stepped off the width of the road; it was 10 feet wide. The snake was a king cobra.

Gtauree Mandal (white shirt) selects fish that will receive hormone injections to facilitate spawning, near Katmandu, Nepal.

Nepal

In 1995, Pete Kennedy, CEO of C-K Associates, Inc. (an environmental company), and James W. Avault Jr. of the LSU Agricultural Center traveled to Katmandu, Nepal and then on to the New Life Mission and Orphanage near Jutpani. Avault's role was to suggest methods for improving the fish growing operation. Kennedy had an interest in helping the orphanage. Prem Pradhan was the founder and manager of the mission and orphanage.

Here is his story. In his younger days he was a mercenary for the British Army. He soon learned the ways of the country, and became a Christian. When he returned to Nepal he founded a Christian mission and orphanage where children were taught to read and write, among other things. At the time few people in the country could read or write. The king put Pradhan in prison. Christians were not tolerated by him; about half the people in Nepal are Hindus. His prison cell had a dirt floor with a tree growing in the middle. Pradhan's left leg was chained to the tree. When the king died the new king released Pradhan from prison. In fact he honored Pradhan, who was helping children to have a better life.

The orphanage, as we saw it, was simple and relatively self-sufficient. Not far away in Nepal, near the border with Tibet, stood Mt. Everest. Children grew vegetables; there were chickens, water-buffalos, cows, and goats. Cows were considered sacred but water-buffalos were not. A large cast iron pot under a tree was used to cook two meals a day for the children. Goat meat

was eaten about once a month. There was no electricity or running water. With all of these fine amenities, I never saw such happy children. Kennedy brought a suitcase full of chewing gum. Each child got a stick. All day long you could hear pop, pop. Near dark the children stopped playing, kicked off their sandals, and came inside. The chewing gum was stuck on the wall. The next morning it was picked off the wall and chewed again.

When Kennedy and I first arrived at the orphanage it was late afternoon. It had been a long journey. Whenever I arrive in a foreign country the first thing on my mind is safe drinking water. The second thing is to get a map of the country, if available, to see where I am and where I might be going. Because Nepal is so mountainous, dashed lines on the map show trekking routes, walking only. Regarding drinking water, Brother Prem offered us a drink of cool water. He said that it came from an underground spring that was fenced off so animals could not reach it. A bicycle tire pump brought the water to the surface.

We still had some daylight left after our arrival, so he asked if we would like to see the ponds. We saw 12 ponds, each about 0.15 acres in size. Seepage from spring water helps to keep water in the ponds, plus water is added during the rainy season and by pumping from a shallow spring. The original purpose of the ponds was to provide irrigation for the vegetables grown by the children. At some point fish were added to ponds and fed ag byproducts and table scraps. The fish provided animal protein to the diet of the children. Then someone suggested that the ponds could be used to raise fingerling fish which could be sold for cash to farmers. Some of the ponds were used for this purpose. We saw Gtauree Mandal, from India, inject catla carp with a mixture of ground-up carp pituitary and a synthetic hormone, possibly HCG. But there was a major problem in grow-out of fry to fingerlings. The fry when stocked into ponds just seemed to disappear.

Peggy T. Avault enjoying boiled crawfish. She supported this author and our program every step of the way.

This was a mystery to Pradhan and to others. However this same problem has been seen at national fish hatcheries and elsewhere in the US; it was caused by a predacious insect called a backswimmer. We told Pradhan why the fry disappeared, but he was concerned about the cost to correct the problem. Everything that we needed was on hand at the orphanage: A 5-gallon bucket was found; used motor oil, and diesel fuel were on hand. An empty tin can, which served as a dipper, was the last thing found. We combined the diesel fuel and motor oil in a 50-50 mix and spread it lightly on one side of a pond; a gentle breeze carried the oil slick across the pond. When the insects came to the surface to get air their breathing tubes were clogged, and they died. We treated all of the ponds. It was suggested that this same procedure be repeated once a week with all ponds until fish reach two inches or more in size.

Shortly before dark Pradhan's wife caught the chickens and put them up. We were told that a roving tiger sometimes passed through the area. None of the rooms in the orphanage had doors much less locks. The next day we had visitors from the Peace Corps. They said that they would check with Pradhan on a regular basis to help him with his fish farming. Further, while in Nepal, we were able to contact some FAO folks, and they too would look out for the orphanage (FAO Fisheries Circular 896).

Summing it Up

The fisheries and aquaculture program had a modest beginning in 1949 within the School. Since then we have seen the program grow: Faculty have been added, courses and curricula have been developed, students were educated, names of the School and of agriculture have been changed. Agriculture became its own campus with its own chancellor, ponds were built one pond at a time, aquaculture became a branch station. We hosted conferences of the World Aquaculture Society and of the International Association of Astacology and through research and extension, the crawfish and fish farming industry grew. Research in the Atchafalaya River Basin, and elsewhere in natural fisheries, provided knowledge to manage these resources so we could enjoy them for years to come. Foreign service has helped many to a better life.

Based on research by many people, foreign service, plus this author's practical experience, the textbook "Fundamentals of Aquaculture" was written.

Why has the fisheries and aquaculture program been so successful? There are many reasons. Louisiana is blessed as a state with an abundance of natural resources, and people who know how to enjoy them. Concomitant with this our program contributed through teaching, research, and extension. Further, you will find that with any successful event or accomplishment many people work together in concert. Throughout the development of our program so many people from so many diverse areas came together as one.

A Final Note

The history of the fisheries and aquaculture program does not end with this report. The contribution of the LSU AgCenter is ongoing. People continue to step forward. Through teaching, research, and extension they contribute to the economy of our state's fisheries.

Acknowledgements

John D. Wozniak, of the LSU AgCenter, played a major role in putting this report together. Thank you John. Photos were provided by the Louisiana Department of Wildlife & Fisheries (identified), the School of Forestry, Wildlife & Fisheries, the LSU AgCenter and by this author.

Some Abbreviations

LSU — Louisiana State University

School — School of Forestry, Wildlife & Fisheries

LAES — Louisiana Agricultural Experiment Station

LCES — Louisiana Cooperative Extension Service

Division — Division of Continuing Education

USL — University of Southwestern Louisiana

WAS — World Aquaculture Society

WMS — World Mariculture Society

IAA — International Association of Astacology

LDWF — Louisiana Department of Wildlife & Fisheries

DPW — Department of Public Works

LL&E — Louisiana Land & Exploration Company

Basin — Atchafalaya River Basin

USFWS — U.S. Fish and Wildlife Service

NMFS — National Marine Fisheries Service

USDA — U.S. Department of Agriculture

USAID — U.S. Aid for International Development

FAO — Food Agriculture Organization