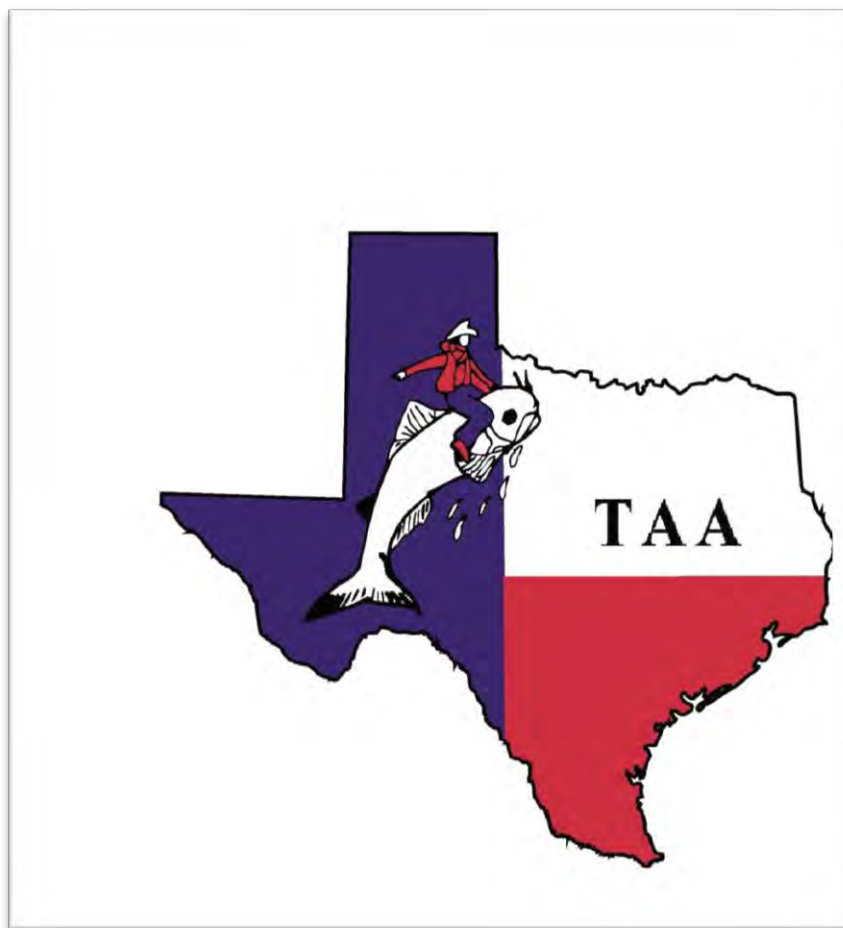


**A Historical Compilation of Texas Aquaculture Photos to Celebrate the  
Texas Aquaculture Association's 40<sup>th</sup> Anniversary in 2010**

**Compiled by Granvil Treece, Robert Schmid and Donna Hanson**

**January 2010**



The Texas Aquaculture Association is an association of entities with an interest in aquaculture that spans commercial production of shrimp, redfish, tilapia, channel catfish, hybrid striped bass, baitfish production, production of stocker fish, production of ornamental fish, and pond and lake management.

The role of the association is to provide for an industry-wide exchange of information and to act as a voice of the industry in dealing with federal and state regulatory agencies.

The Texas Aquaculture Association (TAA) was not always called TAA. The organization was originally referred to as Catfish Farmers of Texas and at one point then referred to as Fish Farmers of Texas. They apparently celebrated their 20<sup>th</sup> anniversary (according to the 1990 proceedings) in 1990 at their meeting in Corpus Christi, which would indicate that the organization was established in 1970. Their first conference proceedings was published in 1967 (43 years ago). But the organization did not start counting conferences until 1970. The organization was assisted by TAMU. In 1967, Richard J. Baldauf was Professor and Acting Head, Dept. of Wildlife Science, TAMU and opened the conference and provide support. Dr. Wallace Klussmann, followed with the second presentation. Dr. Klussmann later became head of the TAMU Dept. of Wildlife and Fisheries Sciences and continued to support the organization. Under Dr. Klussmann was Dr. James Davis, Extension Fisheries Specialist and Dr. Ken Johnson, Extension Aquatic Disease Specialist, and both these gentlemen carried the torch and flag high for the organization and continued their strong support until they retired. Lee Bartlett was also right in assisting.



Sterling K. "Ken" Johnson is a retired professor and aquatic animal disease specialist from Texas A&M University and the Dept. of Wildlife and Fisheries Sciences. Ken resides with his wife, Mary Lou, in College Station and his son, Kurt with his wife, Becky, reside in the San Marcos area. Both enjoy being outdoors, close to nature, and of course, talkin' crawdad. Ken, along with Dr. Wallace Klussmann, Dr. James T. Davis and later Dr. Don Steinbach were all very supportive of the Catfish Farmers of Texas, later called the Fish Farmers of Texas and later called the Texas Aquaculture Association. Photos of the other gentlemen were not available. Ken and Kurt are authors of a book entitled "Texas Crawdads". More information on the book is available at the web link:

<http://www.texascrawlads.com/home>

At that time, the major aquatic crop raised in Texas was catfish. After 1969, the state of Texas and its Universities started doing research and private investment was committed to other species. In the mid 1970s the freshwater shrimp was a popular crop in Texas, but faded out in the 1980s, when marine shrimp took the lead in the largest crop in Texas, until it peaked in 2003 and began a decline. In 1974, Sun Oil Company established a pilot freshwater shrimp farming operation (Aquaprawns, Inc.) near Brownsville. The firm developed several new techniques for cultivation of freshwater shrimp and marine shrimp, including the use of a harvest pump. In 1978 Sun closed its non-petroleum related subsidiaries and a new company (CSCI, managed by Durwood Dugger) was formed. In 1980, CSCI built a 68 acre freshwater shrimp farm in Los Fresnos and used saline ground water to grow shrimp in its hatchery. The operation was purchased first by Ted Hollin and eventually taken over by Marshall Snider and Sweet Water Aqua-farms, a shrimp marketing group from Brooklyn, N.Y., which operated until an Arctic cold front destroyed part of the crop in Nov. 1991. Snider eventually moved their operation to Puerto Rico, and the facility has not been used since. In 1987 a freshwater shrimp hatchery was established in Weatherford, Texas (Aquaculture of Texas) and Craig Upstrom still operates the hatchery today.

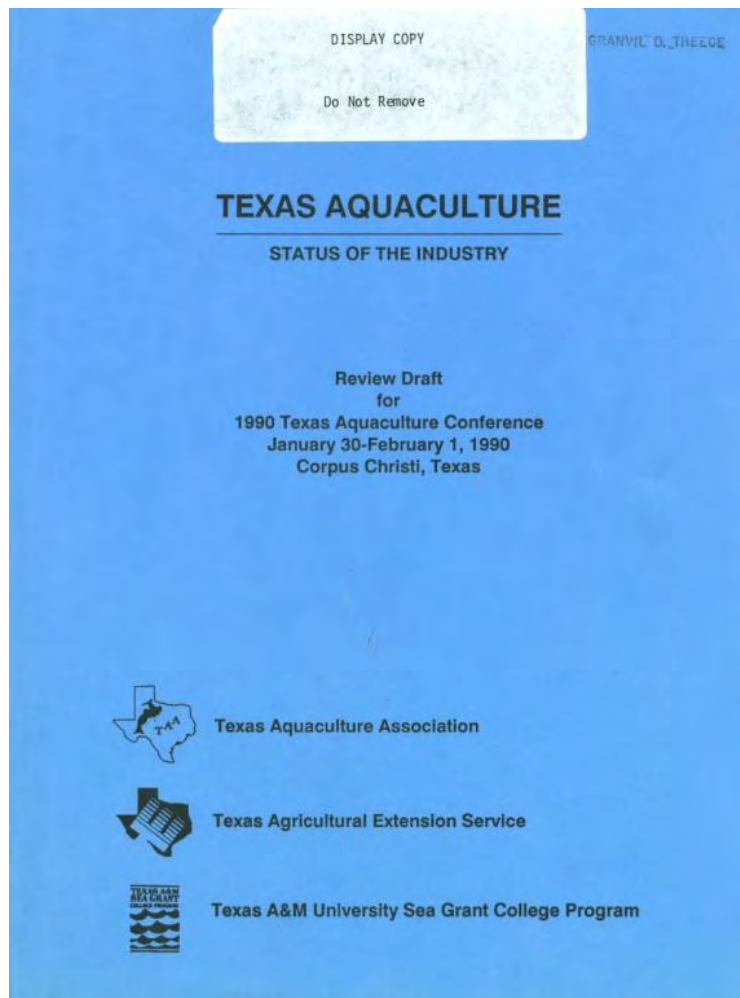
According to the past proceedings published by TAA, in 1974 to 1976 other species were looked at by researchers in the state such as marine shrimp and tilapia. More intensive culture methods and diseases were also being looked at by Texas researchers and extension personnel. Even rainbow trout was looked at in 1976 by Dr. Joe Lock at TAMU extension service.

In 1990, at its 20<sup>th</sup> anniversary, the Fish Farmers of Texas (formerly Catfish Farmers of Texas) decided to change its name to better fit the diversity of species and growing organization. Its name was changed to Texas Aquaculture Association and its conference that year was held at the Omni Hotel in Corpus Christi Jan. 30- Feb. 1 and supported by the TAMU Sea Grant College Program and the Texas Agricultural Extension Service. Catfish has now come back as the major crop in Texas with 28 million pounds produced in 2008 in 3,500 acres of ponds. In reading through the proceedings of the 1990 TAA conference held in Corpus Christi, one can see the following about TAA and when it was first established. According to the forward, TAA was first established in 1970, which would make 2010 its 40th anniversary.

Located in the Forward of the 1990 proceedings, "This conference marked several important events including the passage of the Fish Farming Act of 1989 through the Texas Legislature, the 20th Anniversary of the Texas Aquaculture Assoc., the first year that the conference location was changed from its traditional venue on the campus of TAMU in College Station, and first year that TAA used the conference as fund-raising event". The conference planning committee was: Brian Brawner, George Chamberlain, Mike Haby, David Maus, Russ Miget,



Vance Schultze, and Willie Younger.



## **FORWARD**

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This document was generated in an effort to evaluate the status of the aquaculture industry in Texas for the occasion of the 1990 Texas Aquaculture Conference on January 30 - February 1, 1990, in Corpus Christi, Texas. This conference marked several important events including the passage of the "Fish Farming Act of 1989" through the Texas legislature, the 20th anniversary of the Texas Aquaculture Association, the first year that the conference location was changed from its traditional venue on the campus of Texas A&M University in College Station, and the first year that TAA used the conference as a fund-raising event. The conference planning committee, which consisted of the following individuals is acknowledged for their role in initiating the preparation of this report:

Brian Brawner, Red Ewald, Inc.  
George Chamberlain, Texas Agricultural Extension Service  
Michael Haby, Texas Agricultural Extension Service/Sea Grant  
David Maus, Redfish Limited  
Russell Miget, Texas Agricultural Extension Service/Sea Grant  
Vance Schultze, Tank Hollow Fisheries  
William Younger, Texas Agricultural Extension Service/Sea Grant

The authors of each chapter of this report were asked to survey the current status of the industry, especially the impediments hindering development, and recommend actions needed to stimulate growth. This process has relied heavily on participation by industry, university, and agency staff. The final step in the review process will be to provide a copy of this preliminary draft to all participants at 1990 Texas Aquaculture Conference to solicit their review and comment. Plans are to incorporate the revisions into a final status report which will be printed as a Texas A&M University Sea Grant College Program publication.

The TAA board and some of its members lobbied in Austin in the late 1980s and in 1989 the Fish Farming Act moved the responsibility for promotion and licensing of aquaculture in the state to the Texas Department of Agriculture. However, this mechanism was slow to be implemented in the state because the state legislature did not provide TDA with the funds to do an adequate job. At the next legislative session in 1991 the state legislature required TPWD, TDA and TCEQ to coordinate and streamline the permitting process and gave the state agencies authority to charge fees for their services. The water use or discharge fees set by TCEQ (then TNRCC, old Texas Water Commission) were very high and TAA lobbied and the state legislature set a \$5,000/yr. maximum allowed discharge fee by TCEQ.

TAA Board and Members in Austin, 1989.



## **TAA Presidents**

2009 & 2010

John Turner

2007 & 2008

Paul Dorsett

2005 & 2006

Rob Schmid

2003 & 2004

Brett Rowley

2001 & 2002

Vance Schultze

1999 & 2000

Fritz Jaenike

1997 & 1998

Bob Waldrop

1995 & 1996

Harrell Arms

**Harrell Glenn Arms**, 65, of Dublin died Thursday, Sept. 17, 2009 at Harris Methodist Hospital in Fort Worth. He was born Feb. 6, 1944 to Raymond J. Arms and Mildred Deloris Lane. Arms was the owner of Arms Bait Co. & Fish Farm, a member of the Masonic Lodge, a reserve constable for Comanche County and a reserve Dublin police officer.

1993 & 1994

Carroll Fox

1992

Tim Moore

1990 & 1991

Malcolm Johnson III

1988 & 1989

Jim Ekstrom

1985 & 1987

Calvin A Rihn

**Calvin A Rihn Sr.** 73, of Thrall (formerly of Austin County) died July 21. He served in the US Army. He worked for the prison system in Huntsville and Sugar Land before moving the Thrall. He became manager of Stiles Farm Foundation in Thrall in 1962 and retired in 1997. He was past commissioner of the City of Thrall. He was a past president of the Texas Aquaculture Producers and of the Texas Pork Producers. He was named 1989 Man of the Year in Texas Agriculture by the County Ag Agents Association. Survivors include two daughters, including Gina (Rinn) Freels '87; eight grandchildren; and a sister.

1984  
Bob Lusk

1983  
Tillman Meadows

1982  
Paul Doss

1981  
Billy Edwards

1980  
Wallace Klussmann

1979  
Kenny Zwahr Pres. Wallace Klussmann 1<sup>st</sup> VP. Billy Edwards 2<sup>nd</sup> VP.  
(According to senior member of TAA, Klussmann and Edwards may have served as presidents in later years, 1980 & 1981, and Red Ewald may have served at one point).

Red Ewald

Cecil Deauman

According to senior members of TAA it is thought that Don Carr served as the first president of the organization at some point.

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**TAA scholarships: *Education is a lifetime choice supported by Texas Aquaculture Association through it's scholarship programs.***





**Undergraduate Scholarship winner announced at the 2009 TAA Conference was Bryan Ray. Bryan is attending Texas A&M University, department of Wildlife Fisheries Science, College Station, Texas.**



**2008 Scholarship Winners**

***Red Ewald Scholarship:***

**Kristen Schultze  
Poteet, TX  
Parents: Vance and Ruth Ann  
Schultze  
University: Texas A&M, Major:  
Food Science**

***Graduate Research Scholarship:***

**Christine Savolainen  
Rochester, MI  
University: Texas A&M, Major: MS  
Wildlife & Fisheries Science**

***2006 Scholarship Winners***

<b>TAA Scholarship winner Joshua Schultze, son of Vance &amp; Ruth Ann Schultze of Poteet, plans to major in journalism at Texas Lutheran University.</b>	<b>TAA Scholarship winner Sam Hafele, son of Gene &amp; Ruth Hafele of Friendswood, plans to attend Texas A&amp;M Galveston majoring in marine biology.</b>
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**Harrell Arms Scholarship Fund**

**In Memory Feb. 6, 1944 – Sept. 17, 2009**

The Harrell Arms Scholarship Fund was set up by Harrell Arms in 2007 for undergraduate college students studying aquaculture with a financial need. TAA is currently accepting contributions to the Harrell Arms Scholarship Fund in his memory. Harrell made many contributions to Texas Aquaculture and to the Texas Aquaculture Association over his many years in the industry. He was a successful businessman in our industry and TAA would like to honor him in a way that he would overwhelmingly approve.

## More history on TAA:

Donna Hanson joined TAA in the early 1990s and assists TAA reach its goals each year in serving the aquaculture industry. She serves the organization well and carries the TAA and Texas Aquaculture banner high. The organization is deeply appreciative of all the work that she does for its cause and for being an Ambassador for Texas aquaculture. Donna serves as TAA Executive Secretary and works out of her home in Kemah.



Cindy Schmid joined TAA as Conference Coordinator in 2006 and has done an excellent job with the fish festivals, annual conferences and trade shows.



Rob Schmid served as TAA President 2005-2006 and presents Burt Nicols with an Outstanding Service Award at the WAS/TAA conference in San Antonio 2007.



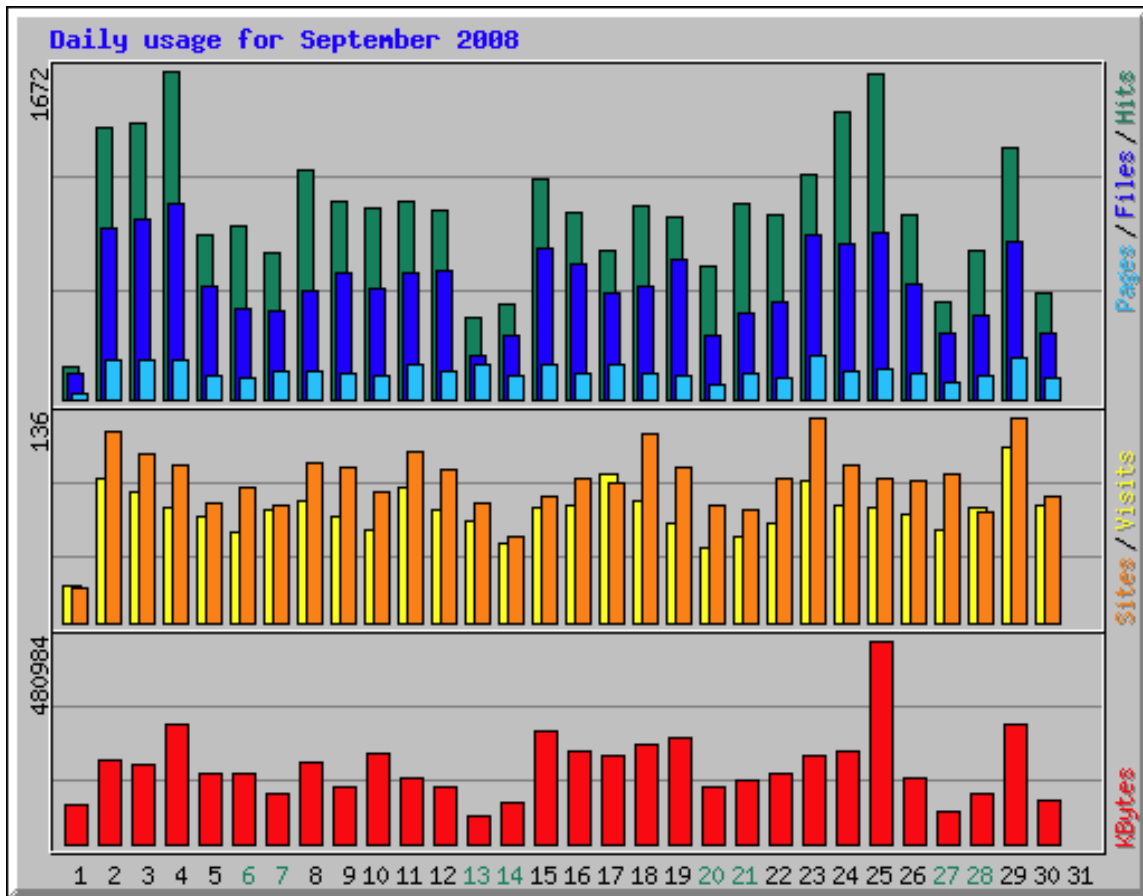
The World Aquaculture Society (US Chapter) holds yearly conferences in the United States, and every 3rd year holds a joint conference with the American Fisheries Society and the American Shellfish Assoc. The 2007 triennial meeting took place in San Antonio. Due to the proximity, the Texas Aquaculture Association chose to coincide their annual conference with that of the WAS. Outgoing 2006 WAS President was Dr. Michael Masser. Here Vance, Brett and Harrell Arms are in front of the TAA booth at San Antonio convention with another out-of-state aquaculture colleague. TAA also facilitated the WAS president's banquet by furnishing farm-raised Texas product from its producers.



Fred Werkenthin with Booth, Ahrens & Werkenthin in Austin provided TAA its first web site in 1999-2000, mainly for regulatory and permitting information and information from the state government in Austin concerning aquaculture. TAA established its own web site in 2001-2002 under the direction of Vance Schultze with the web master's (Gail Treece) assistance. [www.texasaquaculture.org](http://www.texasaquaculture.org). Both web sites added new dimensions to the Texas Aquaculture Association and have allowed the organization to share its information with the world.

## TAA Web Site ([www.texasaquaculture.org](http://www.texasaquaculture.org))

- About Us
- Texas Aquaculture Information
- Hall of Fame
- Scholarships
- TAA Conference
- Conference Sponsors
- Trade Show Exhibitors
- Shrimp Farming Course
- Links
- Aquaculture Suppliers
- Texas Facilities
- Availability List
- Urgent Information
- Members Information



Daily usage and download data for the TAA web site for Sept. 2008.

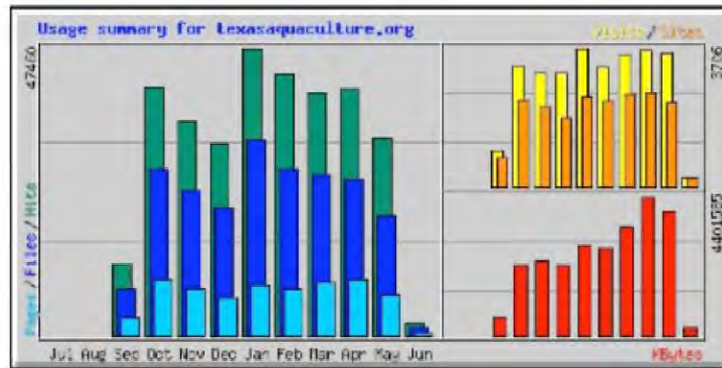
TAA Web Site www.Texasaquaculture.org Daily Statistics for September 2008

Day	Hits	Files	Pages	Visits	Sites	Kbytes
1	166	133	31	25	23	92461
2	1379	869	199	96	127	195883
3	1403	919	202	86	111	187237
4	1672	991	196	76	104	282900
5	839	578	118	70	79	167139
6	880	463	104	60	90	165789
7	743	445	147	74	78	121476
8	1168	552	146	80	106	191440
9	1003	644	126	70	103	132886
10	978	567	116	61	86	214327
11	1003	645	181	90	113	157709
12	961	654	140	74	101	136961
13	417	226	174	67	79	64009
14	483	320	114	53	57	97451
15	1121	773	172	76	84	264497
16	953	685	127	78	95	217627
17	757	535	174	99	93	210868
18	985	575	136	81	125	232881
19	928	713	122	66	103	249862
20	677	328	79	50	77	135972
21	993	437	129	57	75	152902
22	935	496	106	66	96	164757
23	1143	838	218	94	135	206433
24	1460	794	139	77	104	219780
25	1651	852	151	76	95	480984
26	936	591	131	72	94	157544
27	494	341	87	62	99	75086
28	759	423	125	76	73	121546
29	1276	797	216	116	136	281574
30	545	341	111	77	84	105422



## Usage Statistics for texasaquaculture.org

Summary Period: Last 12 Months  
Generated 19-Jun-2008 13:51 EDT



Summary by Month										
Month	Daily Avg				Monthly Totals					
	Hits	Files	Pages	Visits	Sites	KBytes	Visits	Pages	Files	Hits
<a href="#">Jun 2008</a>	108	73	20	12	239	247387	230	397	1396	2062
<a href="#">May 2008</a>	1051	635	217	115	2264	3908845	3569	6755	19711	32606
<a href="#">Apr 2008</a>	1358	860	309	122	2521	4401585	3664	9297	25828	40764
<a href="#">Mar 2008</a>	1290	854	283	114	2487	3430903	3539	8783	26499	39992
<a href="#">Feb 2008</a>	1487	945	264	110	2289	2748900	3201	7681	27405	43144
<a href="#">Jan 2008</a>	1530	1044	266	119	2409	2829609	3706	8262	32368	47460
<a href="#">Dec 2007</a>	1019	685	201	98	1847	2228380	3062	6253	21239	31602
<a href="#">Nov 2007</a>	1180	802	253	101	2153	2336439	3040	7598	24065	35421
<a href="#">Oct 2007</a>	1322	882	296	104	2318	2245626	3245	9204	27370	41006
<a href="#">Sep 2007</a>	1672	1099	416	136	780	575880	958	2913	7697	11706
<b>Totals</b>						<b>24953554</b>	<b>28214</b>	<b>67143</b>	<b>213878</b>	<b>325763</b>

## **Publications:**

**TAA** published a proceedings of each meeting from 1967 to 1990, but has elected not to publish proceedings since. However, now the powerpoint presentations from the conferences are posted on the TAA web site after permission is granted from the speakers and the files are posted in a secure format. TAA and its members rely heavily upon SRAC, WAS, Sea Grant, Texas AgriLife Research and Texas AgriLife Extension, TPWD and researchers at UTMSI and TAMU-CC for much of the aquaculture information. TAA produces a quarterly newsletter for its members called Texas AquaNotes, and also posts industry status reports and other current information about Texas aquaculture on the TAA web site.

# **Texas AquaNotes**



Southern  
Regional  
Aquaculture  
Center



July 2002

## Opportunities and Constraints in Marine Shrimp Farming

Jack M. Whetstone<sup>1</sup>, Gravid D. Treece<sup>2</sup>, Craig L. Browdy<sup>3</sup> and Alvin D. Stokes<sup>4</sup>

Shrimp mariculture, the production of saltwater shrimp in impoundments and ponds, originated in Southeast Asia where for centuries farmers raised incidental crops of wild shrimp in tidal fish ponds. The shrimp were not considered of great value. Time has changed this perspective, and shrimp culture has grown into one of the largest and most important aquaculture crops worldwide. All kinds of shrimp (coldwater and warmwater) are highly desirable now in a world market. Most coastal countries have a harvest industry for shrimp, and about 100 of those catch enough to export. More than 50 countries practice shrimp aquaculture. Shrimp culture increased 300 percent from 1975 to 1985, and 250 percent from 1985 to 1995. If it increases 200 percent between 1995 and 2005, world shrimp culture production will be at 2.4 million metric tons (MT = 1.1 standard tons, 2,204.6 pounds or 1,000 kg). According to a report of the Food and Agriculture Organization of the United Nations, world production of farmed shrimp reached 1,130,000 MT of whole shrimp in 1999.

<sup>1</sup>Clemson University  
<sup>2</sup>Texas A & M University  
<sup>3</sup>Marine Resources Research Institute, South Carolina Department of Natural Resources  
<sup>4</sup>Waddell Mariculture Research and Development Center, South Carolina Department of Natural Resources

The major aspects of shrimp mariculture are sourcing or obtaining brood for hatchery production, maturation and reproduction of broodstock, genetic selection, egg and nauplii production, larval rearing, postlarval holding and sales, growout in ponds and raceways, production of bait or edible shrimp, harvesting, processing, and sales to a world market.

### Life cycle

Juveniles and adults migrate offshore, and in the stable environment of the ocean they mature, mate, and spawn eggs in offshore waters (Fig. 1). All but one species within the Family Penaeidae follow this life cycle sequence, although the sequences vary great-

ly among species. Most tropical shrimp eggs are 0.00003937 inches (220 micrometers) in diameter. They hatch within 14 hours at 28 °C (82.4 °F). The nauplius is the first larval stage and it is attracted to light. In natural settings, the shrimp postlarvae (PL) are carried by ocean currents to the protection of estuaries, where they have a diet rich in various sources of nutrition. They remain there until the late juvenile or early adult stage.

The growout phase in bays and ponds generally takes 4 to 5 months (16 to 20 weeks), depending on the environmental conditions, species, and, in bays, the timing of migration to offshore areas.

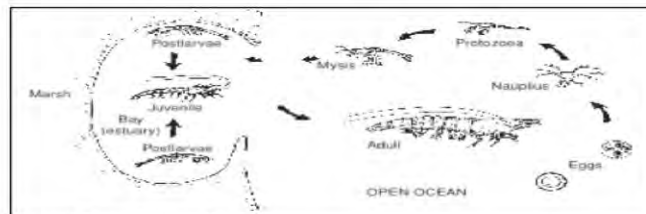


Figure 1. Penaeid shrimp life cycle.

*LABORATORY MANUAL FOR THE CULTURE OF*  
**PENAEID SHRIMP LARVAE**



**BY GRANVIL D. TREECE AND MICHAEL E. YATES**

MARINE ADVISORY SERVICE  
SEA GRANT COLLEGE PROGRAM  
TEXAS A&M UNIVERSITY





# Texas Catfish Production in Ponds



Michael Masser, Professor and Extension Fisheries Specialist  
Peter Woods, Extension Fisheries Program Specialist  
Greg Clary, Professor and Extension Economist  
The Texas A&M University System

**C**atfish farming in the U.S. has grown rapidly since it began in the 1960s. In 2003, 178,000 acres of water were used to produce 661 million pounds (live weight) of farm-raised catfish. About 1,900 acres of water were used in commercial catfish production in Texas in 2004. Most Texas production is on family farms that also produce other agricultural commodities.

More than 90 percent of the catfish produced in the U.S. is sold to processors. Some producers sell live or dressed catfish through local outlets. A few producers develop their ponds for commercial fee-fishing, and others sell their catfish to live-fish haulers who deliver primarily to recreational fishing lakes or live-fish markets.

Catfish can be grown in ponds, cages and raceways, but more than 95 percent of all catfish are produced in earthen ponds. Channel catfish need warm water for good growth; 80 to 85 degrees F is the optimum temperature, though some growth occurs at temperatures as low as 60 degrees F. All regions of Texas are suitable for commercial catfish production. Northeast Texas has about 200 days per year when water temperature is above 60 degrees F, while South Texas may have more than 320 days. Other factors being equal, the longer the growing season, the greater the annual production and return on investment.

The future for catfish farming in Texas is bright. The Texas climate is nearly ideal for production and more catfish is consumed in Texas than in any other state. There are challenges such as uncertain markets, controlling off-flavor, water quality management, bird predation, harvesting difficulties, disease management, and effluent discharge regulations. While the risks are not too different from those of other agricultural enterprises, much more time and effort are needed to manage catfish production than most other crop or livestock enterprises. This publication discusses the basic requirements for successful catfish farming in Texas to help you decide whether this enterprise is right for you.

## Production Economics

Could catfish farming be a wise investment for you? Or, could a higher return be earned by some other agricultural or non-agricultural venture?

**Design, Operation and Training Manual  
for an Intensive Culture  
Shrimp Hatchery**



**Granvil D. Treece  
Joe M. Fox**

**Texas A&M University Sea Grant College Program**

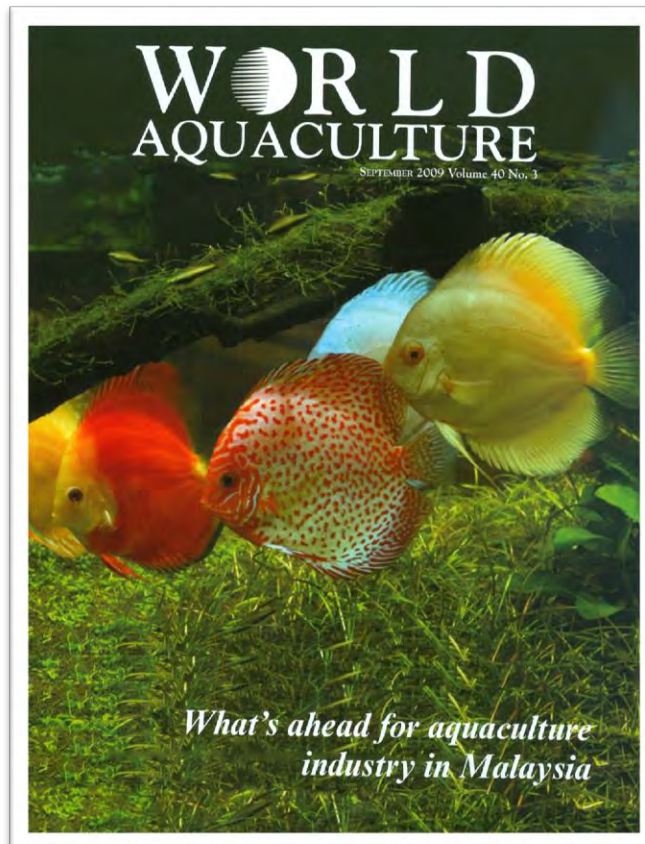


***Shrimp Farming***  
***Technical Assistance***  
***Curriculum***

By

Texas A&M University  
Sea Grant College Program  
Marine Advisory Service  
Texas Cooperative Extension Service

December 2003





# Freshwater shrimp culture is alive and well in Texas

GRANVIL TREECE<sup>1</sup>

Research on freshwater shrimp in Texas was abandoned in the 1970s, but Craig Upstrom of Aquaculture of Texas, Inc., a freshwater prawn hatchery in Weatherford, apparently didn't get the message and has developed a successful and sustainable enterprise. Aquaculture of Texas, Inc. has survived in a tough industry for 21 years. Craig manages and is the majority shareholder in the oldest and largest freshwater prawn (*Macrobrachium rosenbergii*) hatchery in the USA. The hatchery is located in a 1,394 m<sup>2</sup> metal building on Interstate Highway 20 just west of Fort Worth. The hatchery produces six million postlarval shrimp each spring. Craig says that it takes about \$100,000 to pay the bills each year, but somehow it gets done. There have been two other prawn hatcheries built in the eastern USA recently, which have affected sales. The prawns are selling locally for about \$17.60/kg after they are grown in outdoor ponds on several farms during summer months. Because he runs the hatchery himself, with a part-time assistant, Craig needs more time to work on genetics and developing a substitute larval diet to replace expensive *Artemia*. Dr. Delbert Gatlin, of Texas A&M University's Wildlife and Fisheries Sciences Department plans to visit the hatchery and explore the possibility of placing some undergraduate interns in the hatchery dur-

ing the summer to work jointly on needed research. Our hats go off to Craig Upstrom for his hard work in this industry and we hope that he continues to find a niche to survive in this business another 21 years. More information is available on their web site: [www.aquacultureoftexas.com](http://www.aquacultureoftexas.com).

## Notes

<sup>1</sup>Aquaculture Specialist, Texas Sea Grant College Program, 2700 Earl Rudder Frwy. South, Suite 1800, College Station, Texas 77845. Tel. (979) 845-7527

email: [g-treece@neo.tamu.edu](mailto:g-treece@neo.tamu.edu). Website: <http://texas-sea-grant.tamu.edu>.



Craig Upstrom and adult freshwater prawns.



Brood holding area



Growout tank



Macrobrachium hatchery

# Texas Aquaculture History and Growth Potential for the 1990s



Granvil D. Treece  
Aquaculture Specialist  
Texas A&M University  
Sea Grant College Program  
1716 Briarcrest Dr., Suite 702  
Bryan, Texas 7788



# Updated Governmental Permitting and Regulatory Requirements Affecting Texas Coastal Aquaculture Operations



GRANVIL TREECE

Texas A&M University Sea Grant College Program

TAMU-SG-05-501

## Aquaculture Contacts

### Texas Aquaculture Association

P.O. Box 10584  
College Station, Texas 77842  
979-690-1635 Fax 979-690-1965  
TAA@txaqua.net  
www.texasaquaculture.org

### Texas Sea Grant College Program

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2700 Earl Rudder Freeway, Suite 1800  
College Station, Texas 77845  
979-845-7527 Fax 979-845-7525  
g-treece@tamu.edu  
www.texas-sea-grant.tamu.edu

### Texas Agrilife Extension

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102C Nagle Hall  
College Station, Texas 77843-2258  
979-845-7473 Fax 979-845-7103  
mmasser@tamu.edu  
www.wfscnet.tamu.edu

### Texas Parks & Wildlife Department

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Program Leader  
Inland Fisheries  
4200 Smith School Road  
Austin, Texas 78744-3291  
512-389-8037 fax 512-389-4656  
joedy.gray@tpwd.state.tx.us  
www.tpwl.state.tx.us

### Texas Department of Agriculture

Chris Drews  
Coordinator  
Weights and Measures, Eggs  
and Aquaculture  
P.O. Box 12847  
Austin, Texas 78711  
512-463-7401  
800 TELL TDA  
christopher.drews@tda.state.tx.us  
www.tda.state.tx.us

### Texas Commission on Environmental Quality

Wastewater Permitting Section  
(MC 148)  
P.O. Box 13087  
Austin, Texas 78711  
www.tceq.state.tx.us

### Wastewater Discharge Permits

David Galindo  
512-239-0951  
dgalindo@tceq.state.tx.us

### Aquaculture General Permit

Yvonna Miramontes  
512-239-6922  
ymiramont@tceq.state.tx.us

### Texas General Land Office

P.O. Box 12873  
Austin, Texas 78701-2873  
800-998-4GLO  
www.glo.state.tx.us

### Coastal Leasing

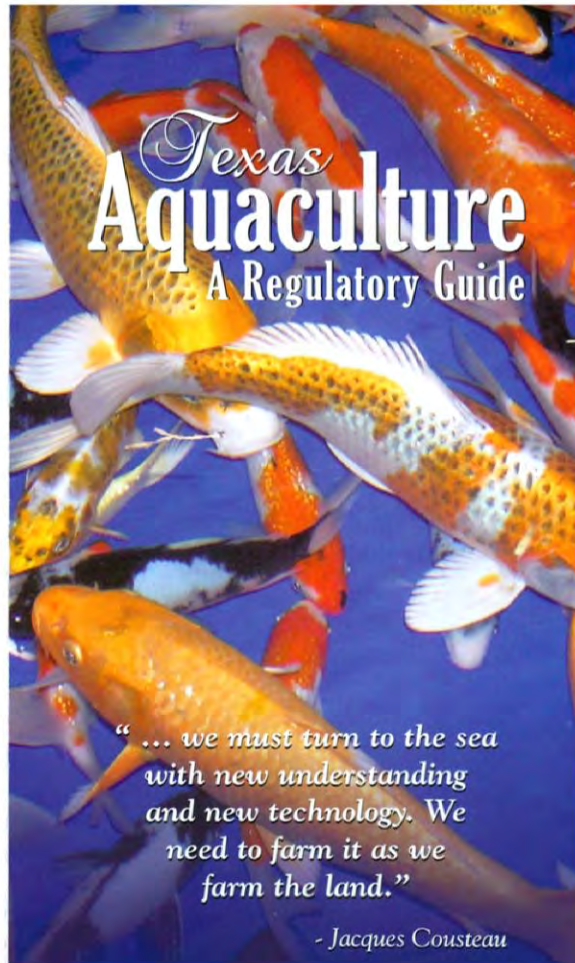
Tony Williams  
512-463-5055  
tony.williams@glo.state.tx.us

### Coastal Management Program

Tammy Brooks  
512-463-9212  
tammy.brooks@glo.state.tx.us

### Coastal Grants, Education & Outreach

Sheri Land  
512-463-5058  
sheri.land@glo.state.tx.us



“... we must turn to the sea with new understanding and new technology. We need to farm it as we farm the land.”

- Jacques Cousteau

## Aquaculture ... the breeding, rearing and harvesting of plants and animals in all types of water environments.



Aquaculture is becoming one of the fastest growing segments of American agriculture. Across the state of Texas, aquaculture businesses are producing, breeding and raising aquatic species in ponds and lakes, fabricated tanks and raceways, or other similar structures.

Three state agencies have regulatory impact on aquaculture in Texas: the Texas Department of Agriculture, the Texas Commission on Environmental Quality and the Texas Parks and Wildlife Department. The Texas General Land Office assists with permit and lease streamlining, and education and outreach for aquaculture.

### TEXAS DEPARTMENT OF AGRICULTURE



The Texas Department of Agriculture (TDA) is responsible for licensing and regulating aquaculture facilities. The TDA establishes record keeping requirements, reviews applications and issues licenses to aquaculture facilities and fish farm vehicles. An aquaculture license is required of persons

who produce and sell cultured species raised in private facilities. A fish farm vehicle license is required if vehicles are used to transport cultured species from a private facility and the cultured species are sold from the vehicles.

For questions or to obtain an application for an aquaculture/vehicle license please contact the TDA at 1-800 TELL TDA (835-5832) or 512-463-7476 or write to TDA at P.O. Box 12847, Austin, Texas 78711. E-mail can be sent to [joe.benavides@tda.state.tx.us](mailto:joe.benavides@tda.state.tx.us).



### TEXAS COMMISSION ON ENVIRONMENTAL QUALITY



The Texas Commission on Environmental Quality (TCEQ) is responsible for the protection of the state's natural resources, which include the protection of water quality. The TCEQ reviews applications and issues wastewater discharge permits to aquaculture facilities that discharge into or adjacent waters in the state.

For questions or to obtain an application for a water discharge permit please contact the Industrial Permits Team at 512-239-4433 or write to TCEQ at P.O. Box 13087, Austin, Texas 78711-3087. E-mail can be sent to [supplif@tceq.state.tx.us](mailto:supplif@tceq.state.tx.us).

Americans consume between 6 and 7 million tons of wild and farmed seafood a year.

### TEXAS PARKS AND WILDLIFE DEPARTMENT



The Texas Parks and Wildlife Department (TPWD) is responsible for protecting the state's fish and wildlife resources. The TPWD regulates the taking, possession and conservation of all aquatic life. Stocking permits are required to introduce any species of fish, shellfish or aquatic plant (native or non-native) into water in the state. Importation or possession of most non-native species of fish, shellfish or aquatic plants is prohibited and the limited exceptions to that rule require an exotic species permit from the TPWD. This protects native species from the introduction of harmful or potentially harmful exotic species. In addition, the TPWD staff assesses the ecological impact of new aquaculture facilities, the law enforcement staff enforces transportation regulations, and the fisheries staff inspects facilities regarding escapement.

For questions or to obtain an application for a stocking permit or exotic species permit please contact the Nongame Fish Permits and Exotics



Species Program at 512-389-8037 or write to TPWD at 4200 Smith School Road, Austin, Texas 78744. E-mail can be sent to [joedy.gray@tpwd.state.tx.us](mailto:joedy.gray@tpwd.state.tx.us).

### TEXAS GENERAL LAND OFFICE



The Texas General Land Office (GLO) and the Texas Coastal Management Program (CMP) can assist Texas aquaculture by streamlining the lease and consistency review processes and by implementing an extensive education and outreach program. The GLO's core mission is the management of state lands and mineral-right properties totaling 15 million acres, including beaches, bays, estuaries and other submerged lands out to 10.3 miles in the Gulf of Mexico.

Growing demand for seafood creates an enormous opportunity for economic growth and new jobs in the U.S. aquaculture industry.

Coastal Leasing is responsible for the negotiation and issuance of instruments of authorization for the use of state-owned land in the Texas coastal area. Coastal Leasing is also responsible for issuing permits, easements and leases on all state-owned coastal lands, including submerged lands in bays and the tidewater limits of coastal lakes, bays, inlets, streams, estuaries, rivers and creeks.

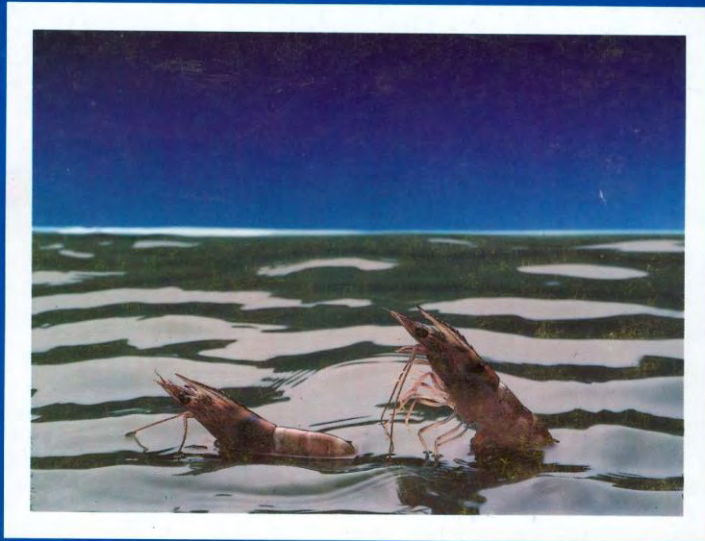
The CMP improves the management of the state's coastal natural resource areas (CNRA) and ensures the ecological and economic productivity of the coast. One of the main functions of the CMP is consistency review. Any project that may affect land and water resources in the Texas coastal zone and requires a federal license or permit, is a direct federal agency activity, or is federally funded must be reviewed for consistency with the goals and policies of the CMP.







# Practical Manual for Semi-intensive Commercial Production of Marine Shrimp



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Aquaculture

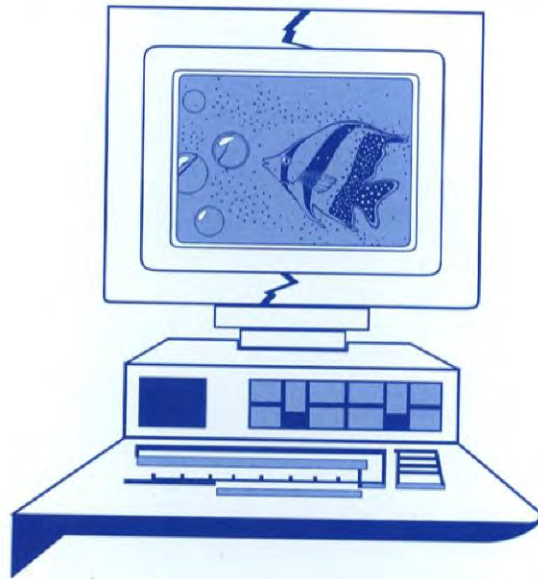
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Jose R. Villalon

with support from  
Granvil D. Treece  
Texas A&M University Sea Grant College Program

# aquaCALC 1.0

SOFTWARE TO AID DESIGN AND OPERATION  
OF AQUACULTURE SYSTEMS



USER'S MANUAL FOR MACINTOSH AND WINDOWS VERSIONS

NICK STARESINIC WITH SUPPORT FROM GRANVIL TREECE

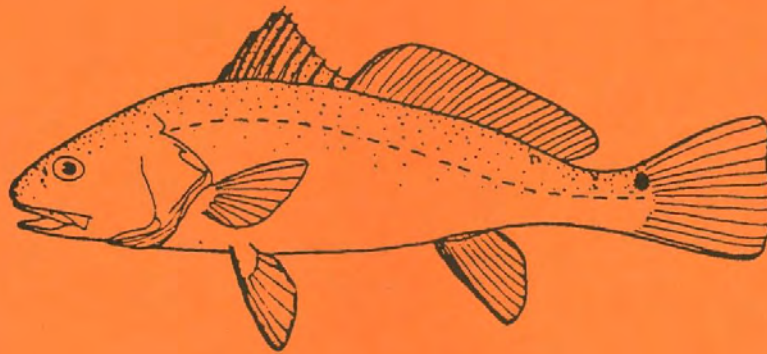
**Sea Grant** A TEXAS SEA GRANT COLLEGE PROGRAM PUBLICATION



GRANVIL D. TREECE

# Red Drum

## AQUACULTURE CURRICULUM GUIDE SPECIES SPECIFIC MODULE



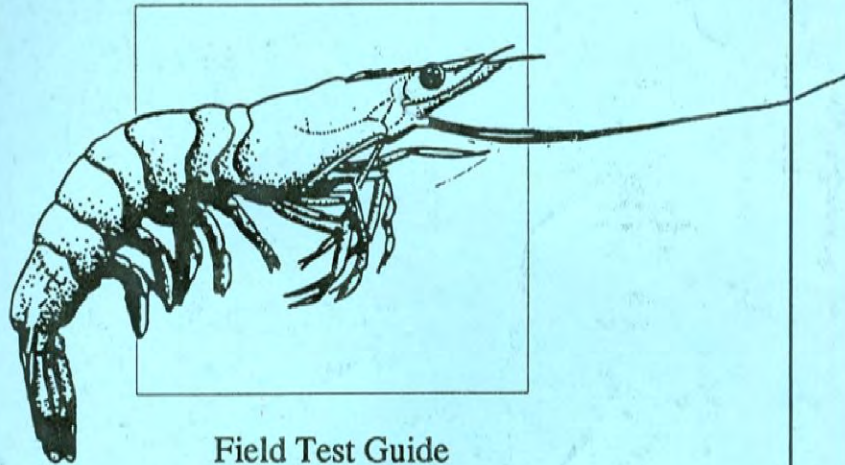
Produced By:  
The National Council for Agricultural Education  
Alexandria, Virginia

With a Grant from  
United States Department of Agriculture  
Cooperative State Research Service

# Aquaculture Curriculum Guide

Species Specific Module

Saltwater Shrimp



Field Test Guide  
May 31, 1993

Produced by:

The National Council for Agricultural Education  
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GRANVIL D. TREECE  
ISSN 082-3449

# RED DRUM AQUACULTURE

Proceedings of a Symposium on the Culture of Red Drum  
and Other Warm Water Fishes



*Sciaenops ocellatus*

## Editors

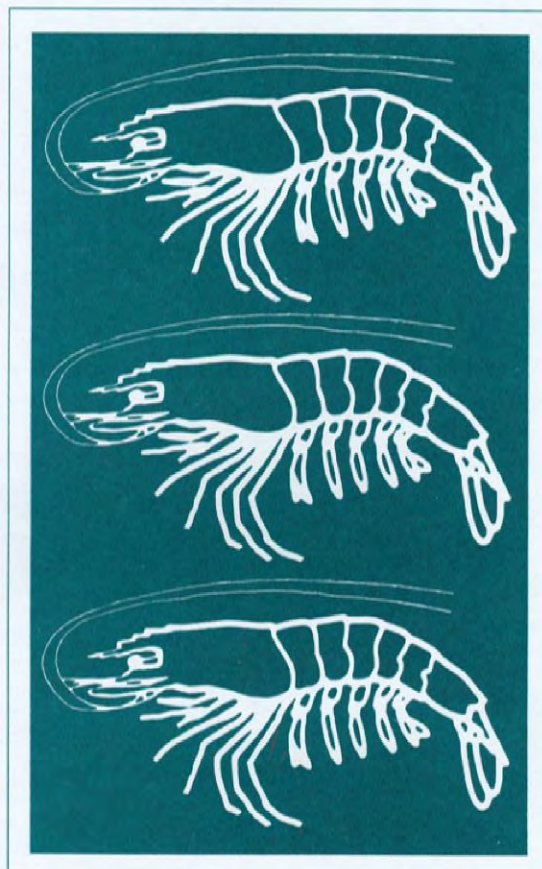
**C.R. Arnold, G.J. Holt and P. Thomas**

**Consulting Editor  
D.E. Wohlschlag**

Contributions in Marine Science  
*Supplement to Volume 30*  
1988

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# Handbook of Shrimp Diseases



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**Aquaculture**

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**S.K. Johnson**  
**Department of Wildlife and Fisheries Sciences**  
**Texas A&M University**

90-601(rev)



TAA tour Tex-Mex Processing and Cold Storage in Brownsville. Tour lead by Tony Reisinger at the end of the conference at South Padre Island



**More history of aquaculture in Texas:** In 1953, Paul E. Heegaard attempted to spawn the white shrimp, *P. setiferus*, in Port Aransas, Texas, and Gunter and Hildebrand worked with the wild shrimp life cycle in 1954 (Gunter and Hildebrand 1954). These were not specific attempts for aquaculture purposes, but added to knowledge of shrimp culture for future aquaculture workers. About that time, the Bureau of Commercial Fisheries, later named the National Marine Fisheries Service, began to work with the biology of native shrimp in the Gulf of Mexico. According to Harry Cook (personal communication, 1992 and printed in Treece, 1993) the Director of the Laboratory, Milton J. Lindner, was successful in obtaining the funding necessary to develop the methodology for a prototype shrimp hatchery system at the Galveston Laboratory. This work was intended to help recognize the different species of shrimp in plankton samples, but also helped future workers understand the techniques required to successfully rear shrimp in the lab. In 1959 Harry Cook was a biologist for the Bureau of Commercial Fisheries and the following account is from an oral interview with Harry Cook by Bob Rosenberry, of Shrimp News International, in 2007.

Three other people were hired to study the life history of Gulf of Mexico shrimp. Wooden troughs about 0.75 m by one meter in diameter were used as rearing containers. When the research started they had trouble finding gravid brown shrimp (*Penaeus aztecus*), so they worked with *Xiphopenaeus*, and published a paper that described the nauplius stage. Later, the researchers were able to spawn brown shrimp and they sketched the various larval stages so that they could identify them in seawater samples. They published the life history of the brown shrimp and a key to the genus. There were researchers in the red tide section of their lab who knew how to culture algae. They relied heavily on the work of Fujinaga but their initial attempts were unsuccessful. The algae and debris would settle and the larvae would concentrate in the corners. The investigators were growing larval feeds in inverted carboys and saw how the water circulation kept everything suspended and the debris from clumping, so they decided to rear the larval shrimp in fiberglass tanks with conical bottoms, with an air stone at the bottom of the cone and around the sides of the tank. They also developed a filter system that allowed water exchange without damaging the larvae. Cook had visited an oyster hatchery on Long Island, New York that was using airlifts in its algae tanks. When Cook returned to Texas, he put airlifts in the tanks, and that basically became the Galveston method: tanks with conical bottoms, airlifts for aeration, a daily batch exchange of water and the addition of live feed, either a mixture of *Skeletonema* and *Monochrysis* for zoea, and brine shrimp for mysis and postlarvae. Cook published on the subject from 1965 to 1971. Although the conical tanks are rarely seen now, this general method is still in use today in many Western hemisphere hatcheries. The Galveston method generally used a number of different algal feeds, but eventually evolved into a combination small cell algae and a larger cell algae (*Chaetoceros* sp. and *Tetraselmis chui*) as beginning feeds for shrimp larvae.

At that same time, in Florida, Tom Costello and Don Allen at the Miami Lab of the Bureau of Commercial Fisheries used fluorescent light bulbs to grow algae indoors. At the Galveston laboratory, researchers were growing algae in outdoor greenhouses, but eventually fluorescent bulbs and indoor culture became part of the Galveston method (Rosenberry, 2007). Also, as part of the development of the Galveston method, a variety of food types, such as rotifers and nematods were tried, but eventually were dropped and replaced by *Artemia* as food for late stage larval shrimp.

The water in the closed seawater system at the Galveston laboratory had a mineral imbalance that became a major problem. In England, a researcher reported better production when using EDTA in algal cultures, so the Galveston group tried it and made a major breakthrough. EDTA is a chelator that helps improve water quality by helping the minerals and metals stay free and unbound. With the success of EDTA in algae culture, they decided to put it in the shrimp tanks, and that's when they started getting better larval survival. The Galveston group did not count the algae; they used a spectrometer to get an estimate of algal density.

Another procedure developed in the Galveston method involved replacing the volume removed from the algae cultures to feed the larval shrimp each day with sterilized water and nutrients, so that the algae would grow back to optimum density by the next day. This kept a continuous, clean source of food available for the shrimp with minimal effort and expense.

Although the Japanese research had some influence on the early shrimp research in Texas, Fujinaga's and Mitsutake Miyamura's visit to the Galveston lab in 1963 was not for the purpose of information transfer and was not a turning or beginning point for shrimp culture in Texas as we were led to believe for many years by various historical accounts. According to Harry Cook (personal communication, 1992) the purpose for the Japanese visit (which only lasted a few hours) was to find a place for shrimp growout in the United States. The Japanese wanted to lease East Matagorda Bay, Texas for that purpose, but ended up in Florida and in 1967 established Marifarms, Inc., which operated from 1968 to 1982. A full account of those activities was published by John Chesire (2005). Storm damage and other problems, including environmental concerns, led to moving from the United States to Ecuador (Treece, 1993).

J.J. Ewald worked on the laboratory rearing of pink shrimp, *P. duorarum*, in 1965 (Ewald 1965). It wasn't until after Cook left the Galveston lab that other researchers further developed maturation techniques for shrimp (Rosenberry, 2007, interview with Harry Cook). A newcomer (Cornelius Mock) came to the National Marine Fisheries Service laboratory about the time Harry Cook was leaving, and Mock continued to publish on the Galveston Method. Success in larval rearing stimulated shrimp grow-out trials in ponds during the 1960s and 1970s. In 1968, the Texas Agricultural Extension Service began its shrimp program in Brazoria County. The program was funded through the TAMU Sea



Grant College Program, the Brazoria County Mosquito Control Dist., Texaco, Ralston Purina, and Dow Chemical and set up a 22 pond R&D facility. It was operated by TAMU's Dr. Wallace Klussmann, Dr. Jack Parker and Mr. Hoyt Holcomb. The most significant findings showed that exotic shrimp grew faster than the native shrimp in culture conditions and was reported by Parker in 1974. In 1972, the second TAMU Ag. Extension and shrimp research facility was set up in Corpus and managed by Dr. Fred Conte, and later Dr. Addison Lawrence. In 1974 an expansion to 18 one-fourth acre ponds was completed at the Barney Davis Power Plant facility in Flour Bluff. Texas AgriLife Research still operates this R&D facility today under the direction of Dr. Tzachi Samocha and Josh Wilkenfeld.



TAMU Shrimp Mariculture Project, 18-pond expansion in Corpus Christi, 1974



Perry R. Bass Marine Finfish Research Station, Palacios (TPWD)

Also in 1972, there was interest in aquaculture in West Texas, which started a long, but unsustainable industry there.

Seventeen shrimp producers in Texas on 1,906 acres produced 6,831,238 pounds of shrimp worth \$13,662,476 in 2005. More recent information on Texas shrimp farms can be found at the Texas Aquaculture Association web site <http://www.texasaquaculture.org/>. At one time West Texas shrimp farms contributed significantly to the state's overall farm-raised shrimp production. Six farms with almost 200 acres once made up the industry in West Texas, but only one farm remains in West Texas that is operating on a consistent basis, Permian Sea Organics. Permian Sea Organics (formerly Permian Sea Shrimp Company) in Imperial, Texas has 64 surface acres of ponds. Bart Reid, Owner and General Manager of Permian Sea Organics, stocked only 20 acres in 2005 and produced 20,000 pounds of shrimp. He stocked on a low density basis and raised the shrimp organically, feeding only 24 thousand pounds of feed and the shrimp utilized the natural productivity in the ponds for additional nutritional needs. The survival for the 2005 crop was 70%. As the name implies, Permian Sea Organics has an organic certification for the shrimp raised at the facility. There is a long history of shrimp farming in West Texas, and it has not been easy for the operators whom took on the challenge in the remote area.

Early experiments in West Texas were crude and little data were obtained, other than survival, indicating the biological feasibility of shrimp cultivation in West Texas. Stocking continued, and gradually a body of information has been accumulated supporting commercial shrimp farming there. In the late 1980s and early 1990s Vernon Holcomb, Jack Parker (a different Jack Parker from the Dr. at TAMU) and Charlie McKaskle all tried pilot shrimp farms inland. Holcomb's ranch was in Stanton, Texas; Parker's attempt was made in Crockett County near Iraan, Texas; and Mc Kaskle's ranch was in Martin County. McKaskle produced commercial crops of shrimp (one in 1989 of 810 pounds per acre and another of 2,166 pounds per acre in 1990). In 1990 McKaskle produced 9,100 pounds of shrimp in 4.2 acres. The farms closed for several different reasons. Holcomb's aquifer dried up during a drought year and Parker's farm produced an average of 1,068 lbs./ac. in 1989 but could not get viable seed stock the following year and the bank took the farm.

Durwood Dugger conducted a feasibility study for the Pecos County Water District No. 3 in May 1991 which was entitled "The Feasibility of Aquaculture in Pecos County and Far West Texas". In July 1992 Texas A&M University (TAMU), the Texas General Land Office, and Pecos County Water District No. 3 opened a new R&D Center in Imperial jointly. Redfish and shrimp were grown at the pilot facility consisting of six one-acre ponds. The R&D facility had some problems with ponds sealing the first year, but produced 1,140 pounds of shrimp. The pilot helped pave the way for a commercial group from Florida (Triton) to come in on property nearby the pilot. In 1993 and 1994 Triton produced commercial crops of shrimp and then closed. The Triton farm was purchased by C.E. Selinger of

Odessa, Texas and a group from India and reopened as Pecos River Aquaculture in 2001, and other groups have had crops there since. The farm was leased but not in production in 2006. Production averages from the various farms in West Texas ranged from 3,000 to 4,500 lbs./ac. and some have gone higher. The highest production reported was with the Super Shrimp (*Litopenaeus stylirostris*) in 1996 at the Regal Farm, where 6,000 lbs./ac. was reached. Through the years at various farms and now at his own farm, Bart Reid has played a large pioneering roll in assisting West Texas shrimp farming. The aquifer used by shrimp farms in the Imperial area is the Cenozoic Alluvium, water remaining from the Permian Sea. Farms drew and still draw from the same source. Salinity varies from 10 ppt to 15 ppt. There are no fresh water zones in that area, and no discharge water leaves any farm. This water is not used in any other form of agriculture on a large scale. Some of the farms in the past maintained reservoirs and some had created wetlands, which received the effluent and provided habitat for the endangered pupfish. The surface water seeps back into the aquifer through porous, sandy soils. Red clay soils can be found in the Pecos River basin for making ponds. Permian Sea Organics also utilizes water from the Pecos County Water District #3 when filling the ponds and mixes with the higher salinity aquifer water. Permian Sea Organics is utilizing "organic culture" to better utilize niche markets. According to Bart Reid of Permian Sea Organics, the University of Texas Marine Science Institute and Nichols State University formed the Organic Aquaculture Institute, Inc. (OAI), a nonprofit 501c3, and have been conducting research in organic marine fish and shrimp aquaculture at the Imperial farm. OAI is also doing extension and education as part of its mission. OAI has partnered with the International Initiative for Sustainable and Biosecure Aquafarming (IISBA). Michael Schwarz (Virginia Tech) says the mission of IISBA is to foster academic and industrial collaborations to establish new seafood manufacturing entities. This initiative will encourage sustained production of safe and wholesome seafood products. Initially, the initiative was an open collaboration among the Association Réunionnaise de Development de l'Aquaculture (ARDA; France), Virginia Tech Aquaculture center (USA), Blue Ridge Aquaculture Inc. (VA, USA), the Organic Aquaculture Institute (OAI; TX, USA), Institute Francais de Recherche pour l'Exploration de la Mer (IFREMER, France), INVE (Belgium), and the Virginia Seafood Agricultural Research and Extension Center (VSAREC, USA). IISBA merges international programs of excellence in aquaculture research, extension and industrial application for comprehensive identification, prioritization and implementation of research from scientific validation to industrial realization. Other international private and research-oriented programs of excellence have expressed an interest in partnership with IISBA, and are being evaluated on a case-by-case basis for membership. IISBA had its inaugural reception at the WAS 2006 meeting in Bali, with high levels of interest expressed from aquaculture research, industry, and government programs and agencies around the world. Bart Reid has worked for a number of years to make sure his own practices met the US standards for organic certification. Mainly, he avoided chemicals and antibiotics, did not crowd shrimp in ponds and fed organic feed --

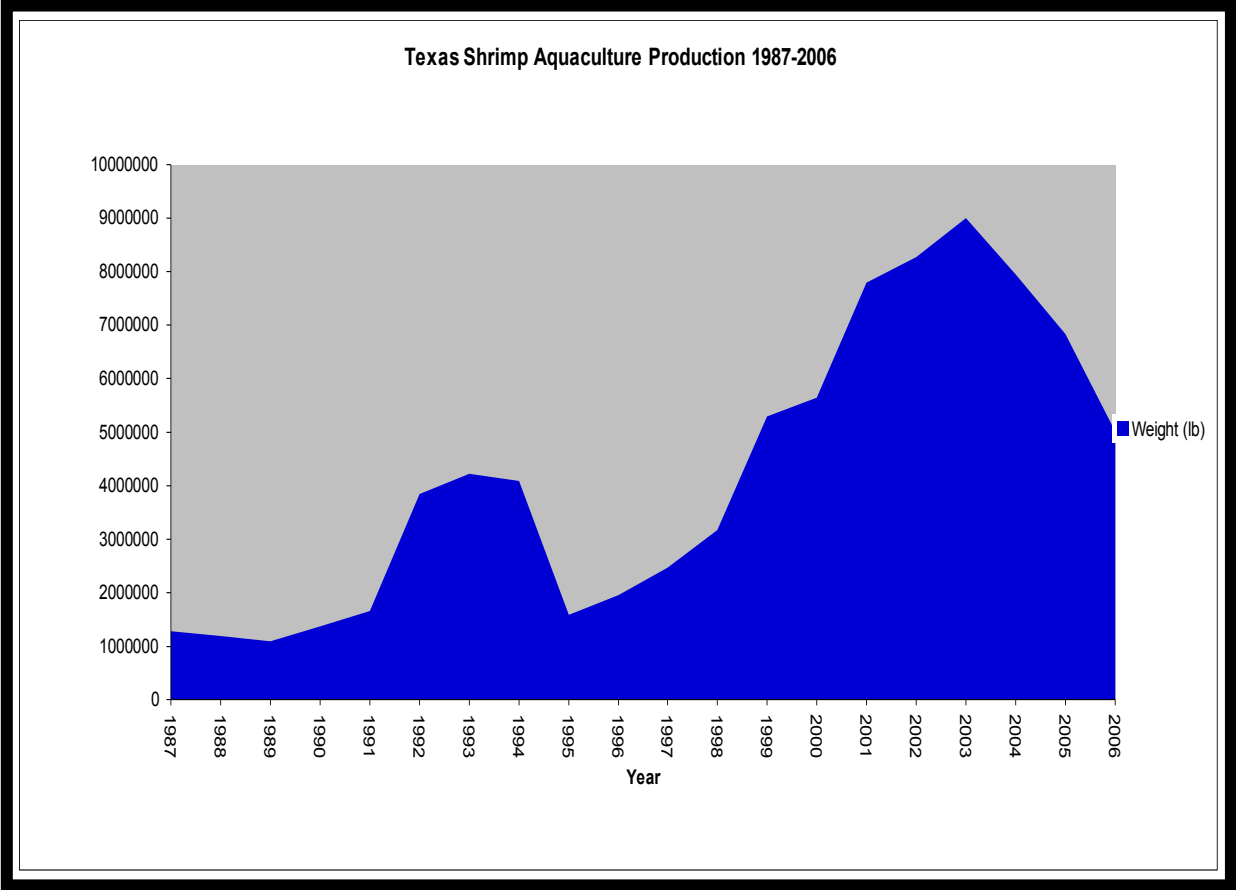
all in line with U.S. regulations. Marty Mesh, executive director of Florida Organic Growers in Gainesville, Florida, said his U.S.-accredited group certified the shrimp "USDA organic" because Reid followed the rules. Reid thought this label might help his products compete with foreign shrimp flooding into the United States from Asia and South America. He claims that he can charge \$5 a pound wholesale for the organic shrimp, compared with \$2 for conventional shrimp. Ground water quantities are still unknown in West Texas and are a source of uncertainty to any operating farm. However, marketing the shrimp appears to be one of the biggest uncertainties and one of the biggest challenges. Some of the shrimp can be sold fresh at harvest to local markets, but that market is easily saturated. The organic certification of the shrimp opens up new markets, mainly in California, where the majority of the shrimp can be sold. Permian Sea Organics has also taken additional steps to open up other markets. Shrimp can be purchased from them over the Internet; however, their shrimp store and restaurant in Imperial was not sustainable and closed down. In 2007 Permian Sea Organics produced 12,000 lbs and in 2008 they produced 7,000 lbs.

In the early 1980s Texas A&M's Shrimp mariculture project, under Dr. Addison Lawrence, set up shrimp hatchery training classes at the TAMU old Fort Crockett facility and NMFS lab in Galveston. The NMFS director in Galveston at the time was Dr. James McVey, whom later became the National Program leader for Aquaculture with the National Sea Grant College Program. Dr. McVey has retired recently. Josh Wilkenfeld, Joe Fox and Linda Smith were just a few people whom worked for TAMU in the Galveston lab training potential shrimp hatchery managers from around the world. TAMU eventually pulled out of the Galveston lab and concentrated their efforts in Port Aransas and Flour Bluff. The Texas commercial shrimp aquaculture industry started in the late 1970s when Dow attempted a project. The first large commercial shrimp farm and hatchery was established in Bayview, Texas by Jack and Sonny Brown from Midland and the Cullin Family from Houston(Laguna Madre Shrimp Farms), later sold in 1987 and was called Harlingen Shrimp Farms thereafter and is still in operation today. Dr. Jack Parker, left the Texas A&M Shrimp Mariculture Project in 1980 and built the farm in 1981 and became the first large commercial shrimp farm operations manager in Texas. Fritz Jaenike was the hatchery manager. Fritz had come over from Chicago's King James Shrimp or Aquabiotics, which grew shrimp indoors.

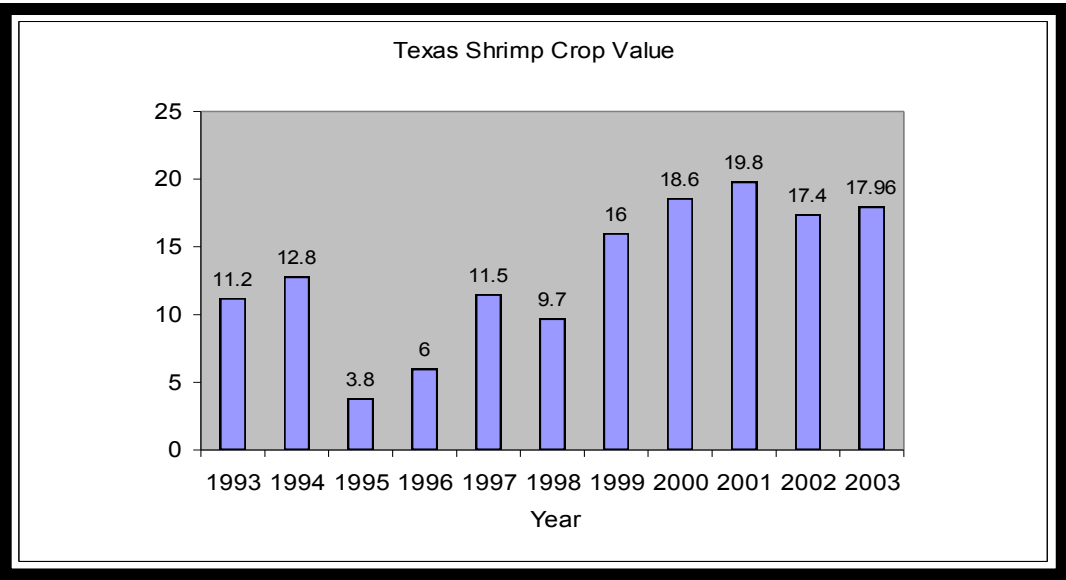
Wolf point shrimp farm was established by Harry Cook and Ocean Ventures Inc. in 1985 at Olivia. Dr. David McKee was one of the investors in Ocean Ventures. Randy Guffey built a 40-acre shrimp farm on Port Bay near Rockport in 1986 and had several crops in following years. Randy now teaches in one of the Rockport schools. The King Ranch built a shrimp farm next to Barney Davis Power Plant in Corpus that had six 20-acre ponds. They, like other Texas farms at the time, had diseases (NHP and IHHN), which were little known at the time, and contributed to the failure and closure. The U.S. Army Corp of Engineers funded the construction and semi-intensive culture of a 230-acre facility on a dredge-spoil island in Cameron County, just off the intercoastal waterway. It worked with a cold-tolerant Chinese shrimp and closed down after several years. The Bowers

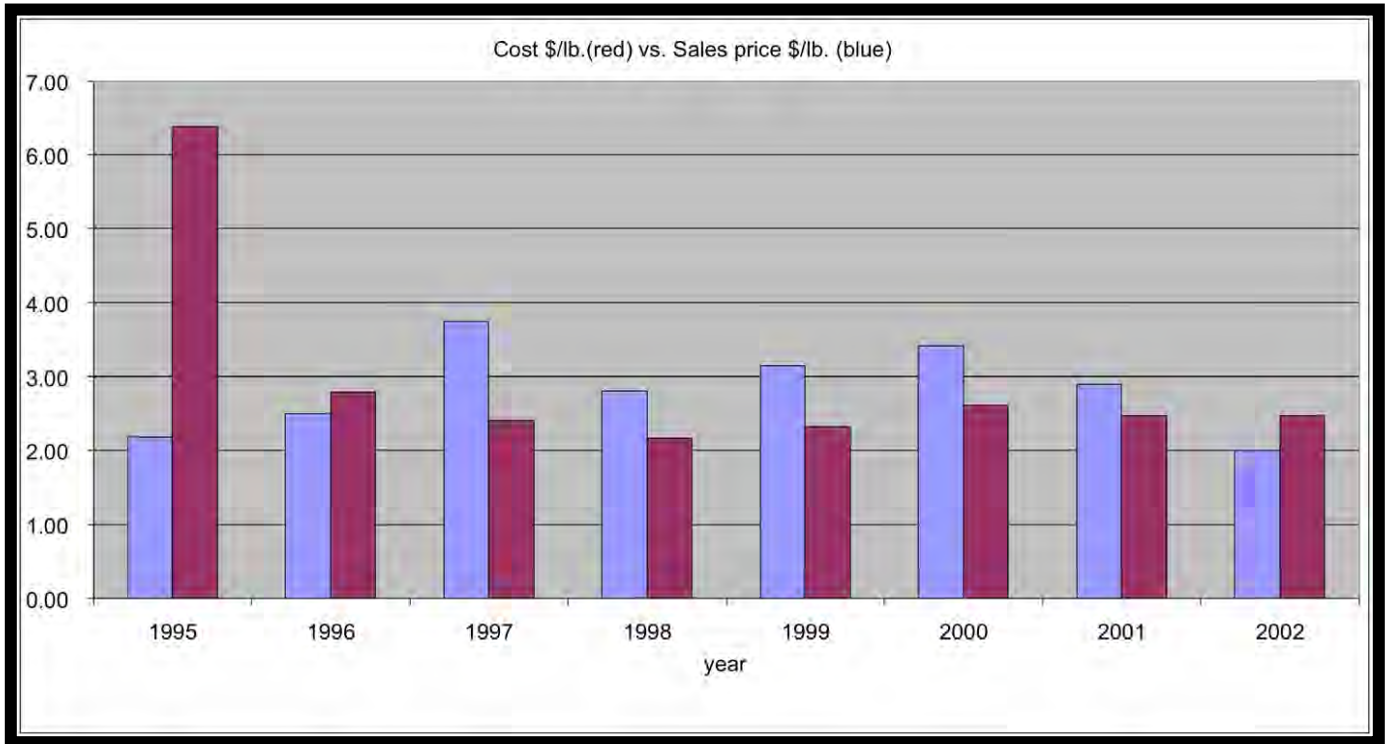
Family started construction on their shrimp farm in Collegeport in 1986 and started production in 1987, and still operating after numerous expansions and building a shrimp processing plant. In the late 1980s and early 1990s several large Taiwanese-owned farms were built in South Texas at Arroyo City. Exotics were mainly cultured, but in 1993 the native white shrimp was grown. The Arroyo Aquaculture Assoc., formerly Chung Mei was 425 acres with 85, 5-acre ponds and Southern Star grew to 1,100 acres of ponds. Bing Hung's Southern Star is now for sale by the banks. In 1995 the white spot syndrome virus hit south Texas shrimp ponds with native shrimp. Corrective measures were taken and the disease has not reappeared since in commercial ponds.





The bar graph below shows the total farm-gate price of heads on shrimp in Texas from 1993 to 2003. 2004 farm gate total was 15.88, '05 13.66 million \$, \$10M in '06, and \$6.8 M in 2007.





Texas shrimp cost vs farm gate price

## Ghost Shrimp Problems



The Arroyo Aquaculture Association experienced ghost shrimp problems in ponds in 2002.

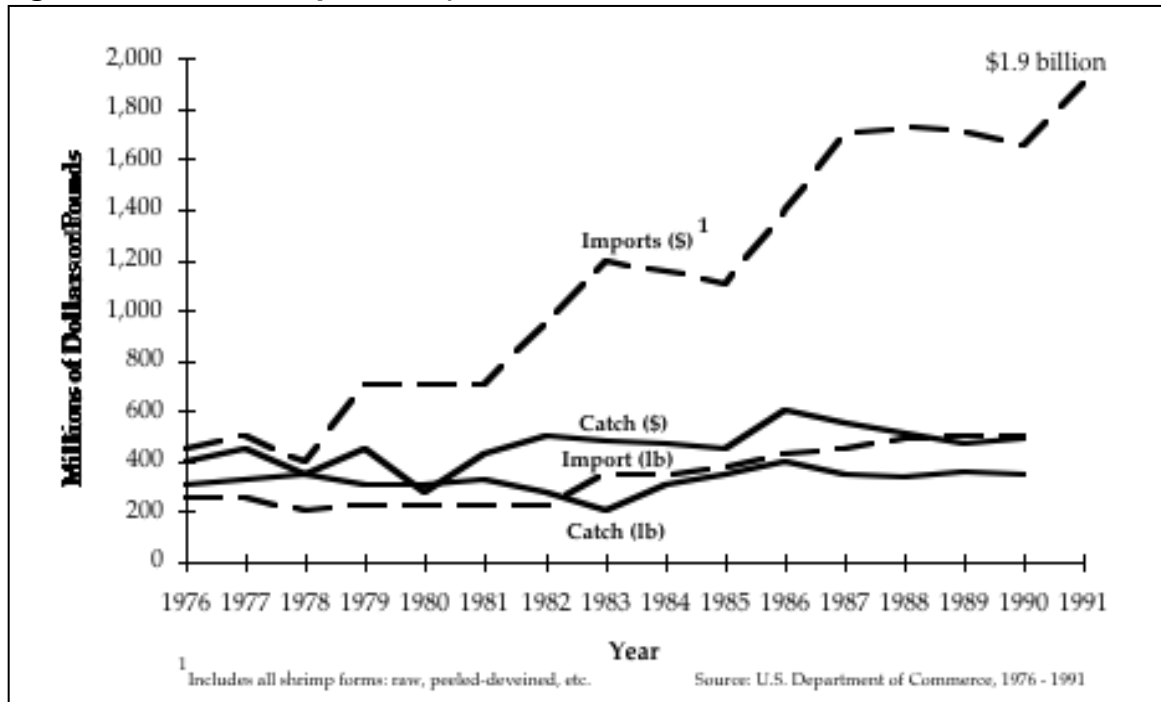
**The Following is taken from Treece, 1993 (Texas Aquaculture, History and Potential in the 1990s). Some material may repeat.**

**Marine Shrimp (*Penaeus vannamei*)**

Farm-raised marine shrimp production in the U.S. was approximately 2 million pounds in 1990 and 3.5 million pounds in 1991. Texas produced approximately 1.4 million pounds in 1990 and 1.5 million in 1991. In 1991, the approximate 1,000 acres of production ponds produced an average of 3,500 pounds of shrimp per acre per year in the U.S, higher than any other Western Hemisphere country and larger than most Eastern Hemisphere averages (Rosenberry, 1991). Only Taiwan and Japan top this average pond production with 3,750 and 7,000 pounds per acre, per crop, respectively. The U.S. produces only a small portion of the two million metric ton world shrimp crop (harvested and aquacultured), and a very small percentage of the 700,000 metric ton world aquacultured shrimp crop. This is only a fraction of the shrimp consumed domestically every year. Domestic landings of shrimp account for 25-35 percent of total domestic consumption and net shrimp imports to the U.S. in 1990 were 502 million pounds (USDA 1991) valued at 1.7 billion dollars (NMFS, 1990). In 1991, U. S. shrimp imports reached 1.9 billion dollars according to USDA (1992) or \$1,856,677,000 according to NMFS (1992). 539,591,000 pounds of shrimp were imported into the U.S. in 1991 (NMFS, 1992).

According to USDA (1991), China, Thailand, and Indonesia shipped a total of over 200 million pounds of shrimp to the U.S. in 1990. Mexico and Ecuador also contribute largely to shrimp imports to the U.S. market, most farm raised. In fact, nearly one shrimp in three supplied in the world today now comes from farms. World shrimp aquaculture production in 1991 was around 700,000 metric tons, up nine percent from 1990, (Rosenberry, Jan 1992: in Fish Farming International, Jan. 1992). The U.S. and Japan are the biggest importers of shrimp. Figure 6 shows U.S. shrimp catch and imports since 1976.

**Figure 6. U.S. Shrimp Catch (—) and Imports (— —)**



## History of shrimp farming in Texas Hatchery

Although other forms of aquaculture have been practiced for centuries in the Eastern Hemisphere, a Japanese researcher (Dr. Motosaku Fujinaga) produced the first written record of shrimp culture techniques in 1934 and the Japanese work in the 1930s and 1940s laid the foundation for other work to follow. This work influenced many groups, including those in the U.S. Those groups working in Texas will be discussed here.

From a listing of the National Marine Fisheries Laboratory, Galveston, Texas, publications and reports related to marine shrimp it can be seen that J.C. Pearson described the eggs of penaeid shrimp in 1935 and the early life histories of some American penaeids in 1939. In 1953, Paul E. Heegaard attempted to spawn the white shrimp, *Penaeus setiferus*, in Port Aransas, Texas. In 1954, Gunter and Hildebrand worked with wild postlarval shrimp in Texas and National Marine Fisheries Services researchers began to work with the biology of commercial shrimps (Lindner and Anderson, 1954). The Texas research to this point did not have aquaculture of shrimp as a goal.

"Research on the culture of larval shrimp started at the NMFS Galveston Laboratory in 1959 as part of an investigation into the life history of commercial shrimp in the Gulf of Mexico. Samples of plankton were taken in the Gulf to study the seasonal abundance of shrimp larvae of the commercial species. There was little information available about larvae of the different species and it was not possible to differentiate the commercial species from the non-commercial species. A project was started to collect gravid females of the various species, spawn them and culture the larvae so that specimens could be obtained for use in identification of larvae collected in the plankton samples. The research program on larval culture was successful and the Director of the Laboratory, Milton J. Lindner, was then instrumental in obtaining the funding necessary to develop the methodology into a prototype hatchery system"(Personal communication, Harry Cook, 1992).

This was the actual beginning of the development of the clearwater hatchery (intensive culture technique), called the Galveston technique by some. From this point it passed through years of refinement and modifications by countless researchers and groups and is still being modified to meet the needs of individual hatcheries. Each group which followed this original group "carried the ball" or "carried the torch" magnificently and helped the cause and helped to spread the knowledge.

Historians like to have a clean and concise date with only one person to cite, so that they can pin point "when and where" an exact science started. It is not that easy with shrimp hatchery developments. Since the 1960s, clearwater hatchery technology (Galveston Method) has had three major contributors or groups of contributors to the development, refinement and transfer of that technology to the international community: 1. Harry Cook and the NMFS staff in the 1960s, 2. Corny Mock and the NMFS staff in the 1970s (when the World Mariculture Society became of age and began to recognize and publish this work, making it more visible to the aquaculture community), and 3. NMFS staff and University Groups (mostly Texas A&M University) in the 1980s (which has continued into the 1990s).

The following is an abbreviated chronological literature search of NMFS Galveston Laboratory publications and reports related to the culture of marine shrimp larvae:

Cook, H.L. 1965. Rearing and identifying shrimp larvae. U.S. Fish and Wildlife Service (U.S.F.W.S.) Circular No. 230.

Cook, H.L. and M.A. Murphy. 1966. Rearing penaeid shrimp from eggs to postlarvae. Proc. S.E. Assoc. of Game and Fish Comm.

Cook, H.L. 1966. Identification and culture of shrimp larvae. U.S.F.W.S. Circ.246.

Cook, H.L. 1966. A generic key to the protozoan, mysis, and postlarval stages of the Penaeidae. U.S.F.W.S. Bull. 65 (2):437-447.

Cook, H.L. 1967. Identification and culture of shrimp larvae. U.S.F.W.S. Circ.268.

Cook, H.L. 1968. Taxonomy and culture of shrimp larvae. U.S.F.W.S. Circ. 295.

Cook, H.L. 1969. Larval Culture. U.S.F.W.S. Circ. 325.

Cook, H.L. 1969. A method of rearing penaeid shrimp larvae. FAO Fish. Report No. 57, 3: 709-715. (Food and Agriculture Organization of the United Nations, Via delle Terme di Caracalla, 00100 Rome, Italy).

Cook, H.L., A. Brown, C.R. Mock and M.A. Murphy. 1970. Larval culture. U.S.F.W.S. Circ. 343.

Cook, H.L. and M.A. Murphy. 1969. The culture of larval penaeid shrimp. Trans. Am. Fish. Soc. 98 (4).

Cook, H.L. and M.A. Murphy. 1971. Early developmental stages of the brown shrimp reared in the NMFS Galveston Laboratory. Fish. Bull. 69 (1): 223-239.

Mock, C.R. and M.A. Murphy. 1971. Techniques for raising penaeid shrimp from the egg to postlarvae. Proc. World Maricul. Soc. 1: 143-156.

The source of these publications was: "List of NMFS Galveston Laboratory Publications and Reports Related to Marine Shrimp (*Penaeus* sp.) Aquaculture". Compiled by: Maurice L. Renaud, Ph.D., Charles W. Caillouet, Ph.D., NMFS-SEFC Galveston Laboratory, 4700 Ave U. Galveston, Tx. 77550.

There were also other groups working on larval rearing of penaeids besides NMFS in the state of Texas. Texas Parks and Wildlife and some of the Universities published works on this subject very early on. One example is:

Ewald, J.J. 1965. The laboratory rearing of pink shrimp, *P. duorarum*. Bull. Mar. Sc. Gulf and Caribb. 15(2):436-449.

Others whom should be recognized (as working on penaeid shrimp in connection with the NMFS Lab, either directly or indirectly), in a historical account are: Dave Aldrich, C. E. Wood, Neal Baxter, D. M. Allen, T.J. Costello, W.W. Anderson, J.E. King, W.C. Renfro, R.H. Rigdon, C. Hanna, G.L. Beardsley, R.J. Berry, M.G. Kleve, D. Patlan, W.H. Clark, P. Talbot, B.R. Salsler, F.S. Conte, M.S. Duronslet, J.C. Parker, J.D. Corliss, Z.P. Zein-Eldin, J.M. Lyon, F. Marullo, A.I. Yudin, R.S. Wheeler, J.L. Fenucci, C.T. Fontaine, R.G. Bruss, I.A. Sanderson, S.E.P. Gislason, W.L. Trent, R.A. Neal, D.B. Revera, R.A. Gould, D. Grajcer, G.W. Griffith, L.A. Ross, E.F. Klima, J.H. Kutkuhn, L.M. Lansford, C.W. Caillouet, K.T. Marvin, A.L. Lawrence, D. Ward, S. Missler, J. McVey, B.S. Middleditch, J.K. Leong, D.H. Lewis, K. Hanks, R.R. Procter, A.K. Sparks, J.R. Adams, A.M. Heimpel, F. Marullo, R.C. Benton, M. Hines, E.S. Chang, J.L. Munro, D. Dimitriou, A.C. Jones, M.L. Parrack, J.C. Pearson, R.R. Proctor, R.C. Benton, R.H. Ridgon, R.D. Ringo, G. Zamora, M.A. Solangi, A.K. Sparks, D. Tave, R.F. Temple, F.W. Weymouth, J.M. Fox, J. Wilkenfeld, Linda Smith, and numerous others.

Although the Japanese research in the 1930s and 1940s did have some influence on work in the U.S., the Japanese (Dr. Motosaku Fujinaga and Dr. Mitsutake Miyamura) visit to the National Marine Fisheries Service Laboratory in Galveston in 1963 was not for the purpose of information transfer and was not a turning point or beginning point for shrimp culture in Texas as we have been led to believe for many years by various historical accounts. The purpose for the Japanese visit (which only lasted a few hours at the Galveston Lab) was to find a place for shrimp growout in the U.S. The Japanese wanted to lease East Matagorda Bay for this purpose, but ended up in Florida and in 1967 established Marifarms, Inc. The project was destroyed by a storm shortly after harvesting had started and later other problems including the environmental problems caused them to move out of the U.S.

## **Growout**

Success in larval rearing stimulated grow-out trials in ponds during the late 1960s and 1970s. In 1968, the Texas Agricultural Extension Service began its shrimp program in Brazoria County.



This program, funded through Texas A&M University's Sea Grant College Program, the Brazoria County Mosquito Control District, Texaco, Ralston Purina, and Dow Chemical Company, developed and expanded into a 22-pond operation. This project was managed and operated by Texas A&M University's Dr. Wallace Klussmann, Dr. Jack Parker, and Mr. Hoyt Holcomb. One of the most significant findings of grow-out trials was that two non-indigenous species, *P. vannamei* and *P. stylirostris*, yielded higher production than native species. In 1972, Ralston Purina's Crystal River Mariculture Research Center (Florida) determined that white shrimp (*P. setiferus* and *P. vannamei*) provided better yields than brown shrimp (*P. aztecus*). This was also confirmed in Texas. In 1972, a second Texas A&M Agricultural Extension Service mariculture facility managed by Dr. Fred Conte and later by Dr. Addison Lawrence- was established near Corpus Christi, Texas, in cooperation with Central Power and Light Company and Ralston Purina. Utilizing technology developed at the Brazoria County facility, a production module was designed and constructed at the Barney M. Davis Generating Station to demonstrate the feasibility of intensive shrimp culture. Consisting of three adjacent ponds of one-eighth, one-fourth, and one-half acre, through which shrimp were rotated as they grow, the tri-pond concept provided better utilization of space and capital investment than previously experienced with single pond units.

At the World Mariculture Society Conference in 1974, Dr. Jack Parker, then with Texas A&M University, reported results of a 1973 small scale experiment conducted by Dr. Fred Conte, Parker *et al.*, (1974). Conte found that *P. stylirostris* performed very well in pond culture, as did *P. vannamei* the first year; but the second year found that *P. stylirostris* performed poorly, and *P. vannamei* continued to produce. Based on these results, Parker, *et al.* (1974), concluded that such a system was capable of producing 2,000 to 3,000 kg/ha (1,800 lbs to 2,700 lbs/ac) during the six-to-seven month growing season available in Texas, but could produce up to 6,000 kg/ha (5,344 lbs/ac) in regions where year around operation is feasible. They also concluded that *P. stylirostris* was not a desirable species for culture under the intensive conditions of that experiment.

Also in 1972, two Ward County gravel pit operators, Mr. Hal Brown and Mr. Dean Phipps asked the local county agent to help them explore the possibility of using the saline ground water in some of their gravel pits for aquaculture. In 1973 County Extension Agent Mr. Johnny Harris, with the help of Dr. Jim Davis and Dr. Jack Parker, stocked the first shrimp using the saline waters of several gravel pits. Early experiments were crude and little data were obtained, other than in a number of cases in west Texas significant numbers of shrimp survived, indicating the biological feasibility of shrimp cultivation in west Texas. Stocking continued, and gradually a body of information has been accumulated supporting the possibility of commercial shrimp farming in west Texas.

July 15, 1992 marked the opening of a new research and development center in West Texas (Imperial, Texas), sponsored by Texas A&M University, General Land Office, and Pecos Water District No. 3. Redfish and salt water shrimp research will be conducted in ponds using ground water

In 1974, construction was begun on an additional complex of eighteen one-fourth acre ponds adjacent to the 1100-acre cooling lake at the Barney M. Davis Generating Station. These ponds complemented the facilities in Brazoria County and allowed capabilities for testing production techniques under the high salinity characteristic of the Laguna Madre, whereas the Brazoria County facilities evaluate production in the lower salinity water of Galveston Bay. Both locations were designed to conduct replicate studies using variations in diet, species, stocking densities, water fertilization, and disease control. Each compared production capabilities of the native white shrimp (*P. setiferus*) against two white shrimp species imported from the Pacific Coast of Central America (*P. vannamei* and *P. stylirostris*) and evaluated stocking densities.

To utilize non-indigenous species, it became necessary to control reproduction in captivity. During the 1970s and early 1980s, methods for inducing reproduction of penaeids were implemented by researchers in other parts of the world and, simultaneously, at the NMFS Laboratory and later carried on at Texas A&M University (Brown and Patlen, 1974; Brown *et al.*, 1980; and Lawrence *et al.*, 1980). Soon afterwards, commercial development efforts in Texas began. Laguna Madre Shrimp Farms in Bayview, Texas constructed hatchery and pond facilities in 1981 after Jack Parker left Texas A&M in 1980. Harry Cook started the second commercial operation in Olivia, Texas (Ocean Ventures, Inc., Wolf Point Shrimp Farm) in 1985. A brackish-

water impoundment near Anahuac was stocked with *P. setiferus* post larvae from Chris Howell's Continental Fisheries hatchery in Panama City, Florida, both in 1984 and 1985. The last commercial source of *P. setiferus* ended when Howell's operation shifted exclusively to the production of *P. vannamei* and produced 70 million post larvae in 1986. Randy Guffey built a 40-acre farm on Port Bay near Rockport, Texas in 1986 and had crops the following two years. A Taiwanese group (MAITAI) has control of the eight five-acre ponds now, and is building a hatchery (foundation has recently been laid). The King Ranch then built six 20-acre ponds for semi-intensive culture and the U.S. Army Corps of Engineers funded the construction and semi-intensive culture trials on a 230-acre facility in Cameron County. MariQuest, Inc. managed these trials and attempted a winter crop with *P. penicillatus*. Other farms have been built since then. In 1989-1990, several Taiwanese companies invested in shrimp farms in south Texas. Chung Mei split into three major groups, stocking a total of 36, five acre ponds (180 acres). The three main groups are: <sup>1</sup> Chung Mei managed by Gordon Lipscomb, <sup>2</sup> managed by Wang, <sup>3</sup> managed by Ching. In 1990, shrimp was cultured in 38 ponds (190 acres) and in 46 of the ponds (230 acres) in 1991. The farm averaged 2,600 pounds of *P. vannamei* per acre in one crop. It is unlikely that its first year's production was profitable. Bing Hung (a major investor into the Chung Mei Farm group) split off from their operation and started his own farm, located nearby, he also obtained ownership of Lone Star Hatchery, Inc. (operated up to that point by the Chung Mei group. The Hung farm completed 78 five acre ponds (390 acres) and cultured shrimp in 46 of the ponds (230 acres) in 1992 They produced 395,400 lbs. in 1991. The Hung farm completed 94 ponds (470 acres) in 1992, and stocked them all. Part of the production from Lone Star Hatchery is *P. setiferus* and according to Dr. Ya Sheng Juan (personal communication) the *P. setiferus* PLs (when produced) will be grown in a nursery pond this year since the time left in the season is too short for full grow-out and these trial results will be used to further expand the culture of *P. setiferus* at the Hung farm in the 1993 season. The farm has additional construction planned up to 600 acres in the future and has additional land, which can be developed.



Hung Shrimp Farm (Later called Southern Star)

Most Texas shrimp farms are located on the coast, but several small-scale, intensive farms have developed in west Texas using saline ground water. All culture the same species, *P. vannamei*.

On June 16, 1989, Harold Bowers received *P. vannamei* postlarvae from Panama (Agromarina de Panama) which was infected with baculovirus (BP). The 120,000 animals were tested upon entering the country; results were reported to TPWD. Mr. Myron J. Hess, TPWD Attorney and Legal aide, instructed Mr. Bowers to quarantine the pond (no water flow in or out) and/destroy the animals. This was done, and the pond was not used the following season. A similar incident occurred in June, 1991, with the Hung farm. Six million postlarval shrimp from Ecuador were found to have BP and the nursery pond was quarantined. Water was pumped out on to dry ground and the animals were captured and disposed of.

In recent history, three pilot ventures in west Texas should be noted. In Martin County, Charlie McKaskle has produced commercial crops of shrimp, one in 1989 (810 pounds per acre) and another in 1990 (over 2,000 pounds per acre). Mr. McKaskle has demonstrated the ability and carrying capacity (27,000 pounds per acre) of greenhouse nurseries to early-start shrimp crops in west Texas. His pilot, one-acre outside growout pond produced marketable sized shrimp at 2,000 pounds per acre considered to be potentially profitable (Dugger, 1991). According to Dr. Jim Davis (personal communication) Mr. McKaskle produced 9,100 lb. of shrimp in 4.2 acres in 1990 and has not had a crop since.

In Crockett County, Mr. Jack Parker (no relation to Dr. Parker formerly of TAMU) also has built a pilot scale shrimp production facility. He also has used a greenhouse nursery system. In 1989, Mr. Parker produced an average of 1,068 pounds per acre from his pilot facility. In 1990,

despite several efforts to restock his ponds, Mr. Parker was not able to receive any viable seedstock during the growing season. Mr. Parker and Mr. McKaskle have both experienced problems in obtaining shrimp seedstock in good condition from distant commercial hatcheries. In the past, Mr. Parker and Mr. McKaskle were able to sell their entire production of shrimp for \$6.50 per pound to the local markets (Dugger, 1991).

The third pilot facility was built at Imperial, Texas by the Pecos County Water Improvement District #3. This six-one acre pond facility was stocked with *P. vannamei* and red fish in 1992, but results were poor during this "learning curve".

In 1991, there were 13 shrimp farms in Texas (not including Redfish Unlimited, located near Palacios, Texas which only stocked shrimp in 1990). There was a total acreage of 1,703 acres (774 ha). In 1990, nine farms-with a total of 461 acres (209 ha)-were stocked and produced a combined crop of 1,405,100 lbs (638 mt) of heads-on *P. vannamei*. In 1991, six farms totaling 768 acres (349 ha)-were stocked and produced 1,513,400 lbs (687 mt) of heads-on *P. vannamei* (see Table 2). The other farms did not stock shrimp in 1991.

Also in 1991, 266,275 lbs. of aquacultured saltwater shrimp valued at \$984,416.00 were killed in four saltwater shrimp farms in Cameron County, Texas during an early November cold snap. A freshwater shrimp farm lost an estimated 22,000 lbs. of aquacultured freshwater shrimp valued at \$254,540.00 during this same period (the same period which 140,000 lbs. of saltwater shrimp were lost at the Port Lavaca Plantation Farm). Water temperatures dropped below 50°F at all the shrimp farms causing these extensive mortalities. The total loss for aquacultured shrimp in Texas during 1991 is estimated at \$1,658,956.00.

### **Potential for shrimp farming in Texas**

Labor costs in the U.S. are generally too high for domestic growers to compete with culturing methods employed by our major suppliers. The Chinese government, for example, supplements their shrimp farming industry by providing seed-stock and sometimes, the army to assist with harvests and pond construction. Another limiting factor is the one crop-per-year limitation in Texas outdoor ponds. Shrimp farmers in the U.S. and Texas must use intensive culture techniques (higher density), to justify the high costs. Even then, there is no assurance that the farm will produce every crop or be profitable even if it does produce once a year. One farm owner who has produced 300,000 pounds of whole shrimp from 60 acres of ponds for the last two years has still not been able to make the farm profitable. He states that "there are many soft or hidden costs that keep you down". What it boils down to is just another way of farming. If you do everything right and nothing goes wrong, you have a good year. This seldom happens, but when everything comes together, the returns can indeed turn out the way they did on paper before starting.

In the past, a major impediment to the growth of shrimp farming in Texas was the quality and availability of postlarvae. Postlarvae (PLs) are young shrimp (approximately three weeks old) which are seeded in grow-out ponds. Bacteria, viruses, and other problems have troubled the industry, but progress is being made to assist the industry in coping with all these problems. Unfortunately, there have been far more failures than successes in this business. But things are not all grim. A new shrimp hatchery was built in Port Isabel and another under construction in Port Mansfield should be productive during 1993. These should double PL production for Texas.

Hopefully, with the increased number of hatcheries there will not be a shortage of high-quality PLs in the 1993 coming season. With "Specific Pathogen Free animals" (SPF) as broodstock in Hawaii and off-spring from these SPF animals being called "High Health Animals" in many other U.S. hatcheries, the PL quality should be much improved and the domestication of this shrimp species should proceed. "High Health" animals have originated through the assistance of USDA regional aquaculture funding. USDA, (through their U.S. shrimp farming program and the Gulf Coast Research Laboratory Consortium) has developed a "Specific Pathogen Free" (SPF) shrimp. Those shrimp have been quarantined in Hawaii and certified to be free of IHHNV, HPV, BP-Type virus, Microsporidians, Gregarina, Nematodes and cestodes. Test results using SPF animals indicate superior growth and survival compared to controls, (Castille, 1992 and Perez, Ecuador, personal communication). A number of different teams have drawn the same

conclusions as a result of tests with SPF animals, and it appears that the entire industry will soon move to obtain these "High Health" Animals.

Also, progress has been made in dealing with a gut disease problem referred to as granuloma. Intra cellular gram negative bacteria (Johnson, 1989, page 5) have been found to cause problems, and treatment with medicated feeds is possible with early identification of the problem. Researchers in the College of Veterinary Medicine at Texas A&M University and a private farm were able to obtain permission from FDA to administer medicated feeds to shrimp the last two years with very positive results. The intensive culture farm produced approximately 300,000 pounds of heads-on shrimp from 60 acres of ponds in 1990 and 1991.

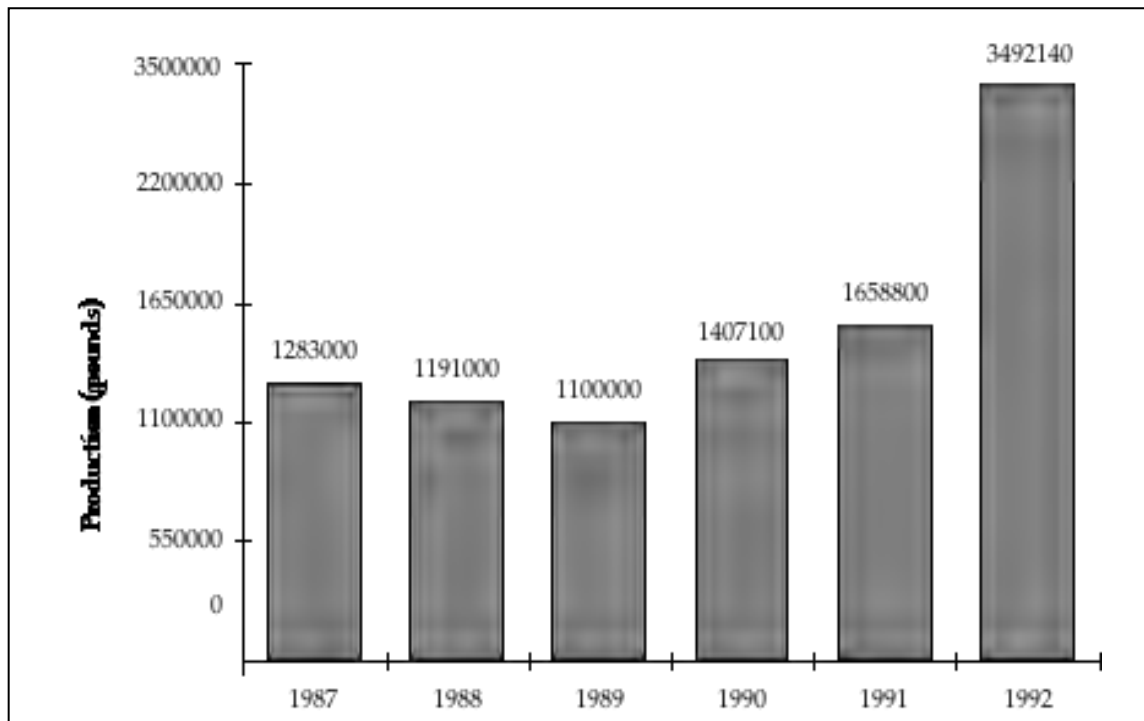
Marine shrimp aquaculture has expanded in Texas the last three years despite its problems. Figure 7 shows the historical production of farm-raised shrimp in Texas.



**TABLE 2. Texas Shrimp Aquaculture Production for 1990 and 1991**

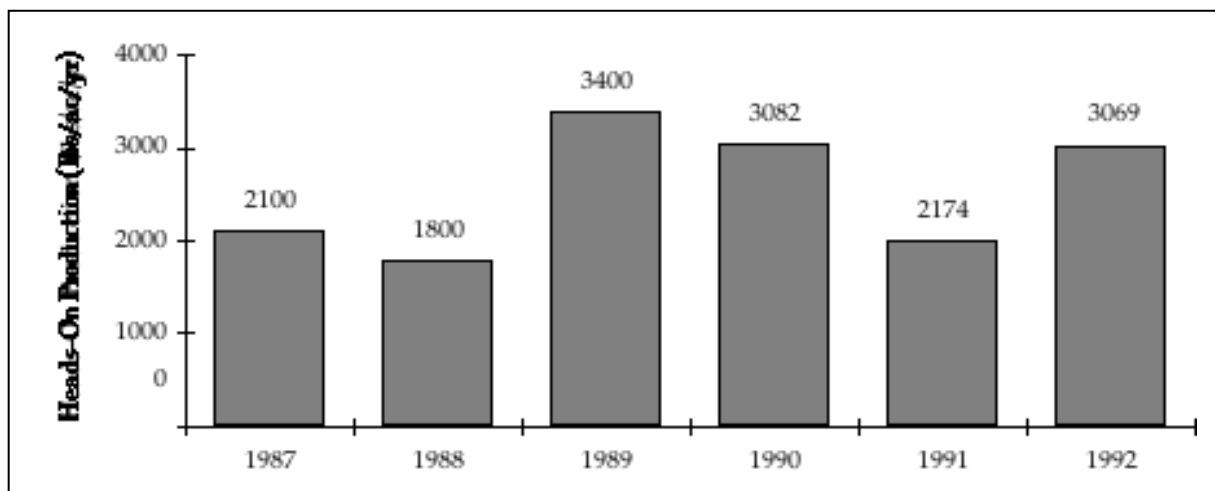
Shrimp Farms Production Lbs.	Pond Acreage Completed		Acreage Stocked		Heads on	
	1990	1991	1990	1991	1990	1991
Hung's Shrimp Farm	0	390	0	230	0	275,000
Chung Mei	190	425	190	230	500,000	275,000
Ocean Ventures Wolf Point	60	60	60	60	330,000	300,000
Harlingen Shrimp Farm	450	450	120	180	320,000	550,000
Port Lavaca Plantation	28	28	28	28	94,000	0
Bowers Shrimp Farm	40	40	40	40	128,520	113,400
MAITAI (formerly Guffey's)	40	40	0	0	0	0
Lone Star Aquaculture	12	12	12	0	48,000	0
Redfish Unlimited	7	not used	7	0	29,000	0
McKaskle's	10	10	4	0	9,100	0
Totals	837 ac	1455 ac	461 ac	768 ac	1,458,620 lbs	1,513,400
	380ha	661 ha	209 ha	349 ha	638 mt	687 mt

**Figure 7. Historical Production of Farm-Raised Marine Shrimp in Texas**



Even though the average yield from commercial marine shrimp farms dropped in 1991, it climbed back to 3,000 lbs./per acre per year in 1992 ( Figure 8).

**Figure 8. Historical Average Yield from Commercial Marine Shrimp Farms in Texas**



Marine shrimp farmers in Texas do not culture the native species (*P. setiferus*, *P. aztecus* and *P. duorarum*). Research and commercial experiences have proven that *P. vannamei*, a Pacific white shrimp, yields higher production; consequently all farming operations have selected this variety to raise. This has created an impediment to the industry in the form of regulatory controls. *P. vannamei* is an exotic species. As a result, TPWD places restrictions on production facilities that many feel are too cumbersome. The Texas Department of Health (TDH) allows polyculture or the combination of shrimp or fish and other shellfish, such as oysters and clams. However, they are only mandated to check and regulate public waters (not private waters), therefore they do not have the personnel and budget to allow the farmer to deplete-or-purge the shellfish in approved waters under strict supervision. This may be changing. TDH may allow private approved laboratories to test the shellfish grown for human consumption.

The Texas coast is well suited to marine shrimp farming. It has an abundance of natural resources which give it a distinctive advantage over most states. Most notable is land that has favorable clay content and sufficient elevation, factors which greatly reduce pond construction costs. Also, water quality and moderate temperatures enhance Texas shrimp-growing capabilities.

Marketing methods vary with the size of the farm. Smaller operations usually sell to local customers, or pool their products with others for distribution. Larger operations sell directly to processors, or have their shrimp processed and market their own product. Some of the farm-raised shrimp in Texas is marketed head-on. Farm-gate price averages between \$2.50 and \$3 per pound. In 1990 and 1991, one farm marketed its entire crop (300,000 lbs.) in California for \$5 a pound. One of the larger farms has its own marketing branch which generally tries to sell the crop to a large supermarket chain. One processor in Brownsville has added a deheading line to accommodate increasing farm-raised shrimp production in the area.

For more information concerning the economics of salt water shrimp farming refer to Lambregts *et al.* 1991 (A comparison of semi-intensive and intensive shrimp farming in Texas).

**Figure 9 Commercial Shrimp and Redfish Aquaculture Facilities in Texas**  
(Locations, Production & Plans)

<b>Shrimp Farms (<i>P. vannamei</i>)</b>	
<p><b>Harlingen Shrimp Farms</b>•Bayview, TX (formerly Laguna Madre Shrimp Farm) Mailing address: Attn: Mr. Fritz Jaenike Rt. #3, Box 300 K Centerline Rd. Los Fresnos, Texas 78566 Total pond acreage: 450 acres Acreage in production 1990: 120 acres Hatchery: 40 million PLs/mo. 1991 production (heads-on): 550,000 lbs. of <i>P. vannamei</i> 1992 - 950,000 lbs,</p> <p><b>Taiwan Shrimp Farm Village</b> • Arroyo City, TX (formerly Chung Mei Shrimp Farm) Mailing address: Attn: Mr. Harry Sun Route 2, Box 469 San Benito, Texas 78586 Total pond acreage: 425 acres Acreage in production 1990: 190 acres 1990 production-(heads-on):500,000 lbs. of <i>vannamei</i> 1991 production (heads-on): 300,000 lbs. of <i>vannamei</i> 1992 Chung Mei Group splintered into 3 groups. total of 36 ponds (180 ac.) stocked. (production was 1,104,000 lbs).</p> <p><b>Port Lavaca Plantation</b>•Port Lavaca, TX Mailing address: Attn: Mr. Ron Parmentier 2203 Vail Drive Port Lavaca, Texas 77979 Total pond acreage: 28 acres Acreage in production 1990: 28 acres 1990 production (heads-on): 94,000 lbs. of <i>P. vannamei</i> 1991 production (heads-on): 0 Freeze killed crop November 1991 1992 no crop. Farm is for sale.</p> <p><b>Lone Star Hatchery, Inc.</b>•Port Isabel, TX Mailing address: Attn: Ko-Lun An P. O. Box 578 Port Isabel, Texas 78578 20,000 sq. ft. shrimp hatchery with primary goal of producing post-larvae for the Hung Farm.</p>	<p><b>Lone Star Aquaculture</b>•Palacios, TX Mailing address: Attn: Mr. Kai Juan Star Route, Box 388 Palacios, Texas 77465 Total pond acreage: 28 acres Acreage in production 1990: 12 acres 1990 production (heads-on): 48,000 lbs. of <i>P. vannamei</i> 1991 production (heads-on): Did not stock 1992 - Did not stock</p> <p><b>Hung Shrimp Farm</b>•Arroyo City, TX Mailing address: Attn: Dr. Ya Sheng Juan One Arroyo Place Arroyo City, Texas 78586 Total pond acreage: 470 acres (94, 5 ac ponds) Acreage in production: 1990, 0: 1991, 230: 1992, 470 1991 production (heads-on): 395,400 lb. of <i>P. vannamei</i> 1992 - 1,200,000 lbs.</p> <p><b>Bowers Shrimp Farm</b>•Collegeport, TX Mailing address: Attn: Mr. Harold Bowers Route 1, Box 534 Palacios, Texas 77465 Total pond acreage: 47.8 acres Acreage in production 1991: 37.8 acres of <i>P. vannamei</i>; 10 acres of red drum 1991 production (heads-on): 113,400 lbs. of <i>P. vannamei</i> 1992 - 238,140 lbs.</p> <p><b>Ocean Ventures</b>•Olivia, TX Mailing address: Attn: John Kinamer Bay City, Texas Total pond acreage: 60 acres Acreage in production 1990: 60 acres 1990 production (heads-on): 332,000 lbs. of <i>P. vannamei</i> (4 ponds produced over 10,000 lbs/acre crop (the best of which produced 12,500 lbs/ac.) 1991 production (heads-on): 300,000 lbs. of <i>P. vannamei</i> 1992 no crop Farm is for sale.</p>

**Shrimp Farms (con't)**

**MAITAI**•Rockport, Texas (formerly) Guffey's Seafood Farm

Total Pond acreage: 40 acres  
 Acreage in production 1991 0 acres  
 1992 - Did not stock. Farm for sale.

**Sweetwater® Aquafarms, Inc.**•Los Fresnos, TX

Mailing address: Attn: Mr. Marshall Schnider  
 P. O. Box 1807  
 San Benito, Texas 78586

Total pond acreage: 70 acres  
 1990 production (heads-on): 21,000 lbs. plus  
 1,200 lbs. Australian Red Claw crawfish  
 1991 Freeze damage resulted in loss of everything  
 but broodstock.

**Brownsville Navigation Dist.**•Brownsville, TX

Mailing address: Attn: Mr. Dick Berry or  
 Gene Cockril  
 Brownsville Navigation Dist.  
 Port of Brownsville  
 P.O. Box 3070  
 Brownsville, Texas 78523-3070

Total pond acreage: 230 acres  
 Acreage in production in 1991 and 1992: 0 acres

**Parker Ranch Seafood**•Iraan, TX

Mailing address: Attn: Mr. Doug Parker  
 10 Meandering Way  
 Round Rock, Texas 78664

Total pond acreage: 3 acres  
 Acreage in production in 1991 and 1992: 0 acres

**Genesis Seafood, Inc.**•Stanton, TX

Mailing address: Attn: Mr. Vernon Holcomb  
 HCR 72, Box 43  
 Stanton, Texas 79782

Total pond acreage: 15 acres  
 Acreage in production in 1991 and 1992: 0 acres.  
 No ground water

**McKaskle's Shrimp Farm**•Stanton, TX

Mailing Address: Attn: Mr. Charles McKaskle  
 HCR 71  
 Stanton, Texas 79782

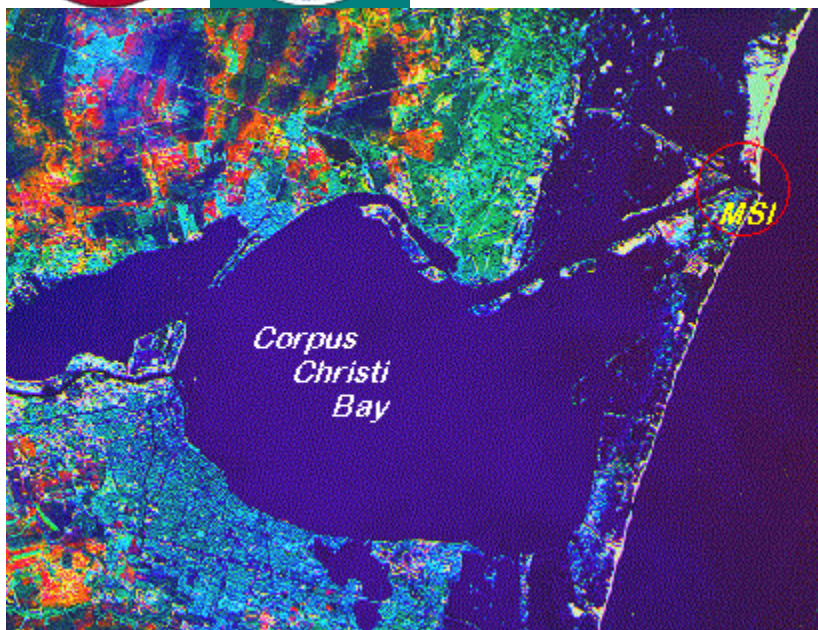
Total pond acreage: 10 acres  
 Acreage in production in 1991: 0 acres

**Pecos County Water Dist. #3.** Imperial, TX

Total Pond acreage: (6) one acre ponds several  
 1/4 acre ponds.  
 1992 895 lbs. *P. vannamei*



The red drum aquaculture research also started early on in Texas. The National Marine Fisheries Service operated a marine fisheries laboratory in Port Aransas, headed by Dr. Connie R. Arnold. In the late 1970s Dr. Arnold and his research staff were able to close the life cycle of redfish in the lab using photoperiod and temperature to encourage redfish broodstock to spawn. In 1976 the Fisheries and Mariculture Lab was transferred to the University of Texas and the Marine Science Institute. Dr. C.R. Arnold stayed with the laboratory and continued the research at that lab under U.T.M.S.I. until he retired. In 1978 the life cycle of red snapper was closed. That lab is still conducting important research in fisheries and mariculture. Through the years, with continued joint efforts with Texas Parks and Wildlife, NMFS, TAMU-CC, Coastal Conservation Assoc. and others, the Fisheries and Mariculture Lab has made important contributions to the state's aquaculture industry and the recreational fishing industry. Interest in red drum culture was very high in the late 1980s and Texas Agricultural Extension Service and TAMU Sea Grant College Program sponsored a red drum conference in 1987 and produced a "how to" manual entitled "Manual on Red Drum Aquaculture", which is still distributed by Sea Grant today. A compilation of research papers was also published on the subject. An industry developed and 5 red fish farms are now operating in the state producing approximately 4 million pounds of fish annually.



## Further Background on Red drum Aquaculture in Texas

*Sciaenops ocellatus* is the second largest member of the drum family in the western Atlantic and Gulf of Mexico, reaching a maximum length of 1.5 m. The world record *S. ocellatus* weighs 42.7 kg. Only the black drum is larger. It is thought that the *S. ocellatus* can live at least 30 years. Sciaenops is Greek for perch-like marine fish and ocellatus is Latin for eye-like colored spot. In the 1950s and 1960s the US Department of Commerce's National Oceanic and Atmospheric Agency (NOAA) - National Marine Fisheries Service (NMFS), conducted fisheries research in the Gulf of Mexico and expanded into marine finfish hatchery production in the late 1960s. One of the most published research facilities for *S. ocellatus* culture, having the largest impact on *S. ocellatus* aquaculture, was the NMFS laboratory in Port Aransas, Texas, directed by Dr. Connie R. Arnold (now retired). In 1975 NMFS downsized its marine finfish research program and moved its personnel to Galveston. The laboratory in Port Aransas was leased to the University of Texas at Austin, Marine Science Institute (UTMSI) in 1976. Dr. Arnold stayed on as the laboratory director for UTMSI and continued marine finfish research on a number of species including *S. ocellatus*. UTMSI personnel cooperated with the Texas Parks and Wildlife Dept. (TPWD), another state agency with fisheries conservation and regulatory authority, and did joint research on *S. ocellatus* hatchery techniques. The red snapper (*Lutjanus campechanus*) spawned for the first time in captivity using the same techniques developed by Arnold et al. (1978) earlier for *S. ocellatus*. Utilizing techniques developed for *S. ocellatus* (manipulations of photoperiod and temperature), other marine finfish life cycles were closed during the period to follow. The laboratory paved the way with its research to establish a viable *S. ocellatus* aquaculture industry in the Southern United States and established *S. ocellatus* and other marine finfish spawning and hatchery techniques, which were used for a stock enhancement program put into place on the Texas coast by TPWD. In 1969 the first state marine fish hatchery (Perry R. Bass Marine Finfish Research Station in Palacios, Texas) was established and TPWD started its *S. ocellatus* program in 1975. The personnel whom started that work, such as Dr. Robert Colura and others, have since retired, but the research and stock enhancement work continues. A second marine hatchery (John Wilson Marine Finfish Hatchery) was built in the Corpus Christi area (Flour Bluff) in 1983, with assistance from the Coastal Conservation Assoc., formerly Gulf Coast Conservation Assoc., and TPWD began stocking selected bays in Texas with *S. ocellatus* to enhance the recreational fishery (a growing multimillion dollar industry in Texas then). There was a 14 million pound [6.35 million kg] per year wild harvest of *S. ocellatus* in the Gulf of Mexico in the late 1970s and early 1980s, much of which came from Texas and Louisiana waters. Partly as a result of a famous New Orleans chef's (Paul Prudhomme) recipe for blackened redfish, a national awareness was created that increased the demand for this species. In 1981 TPWD began lobbying for closure of the redfish fishery. A ban on purse seining of *S. ocellatus* in Federal waters occurred in 1986, and in late 1989 the Texas Legislature passed a law prohibiting the sale of redfish unless it was farm raised. The law prohibiting the sale of wild-caught red fish in Texas went into effect on 30

December 1990. Texas was the first state to remove the *S. ocellatus* fishery from the Gulf by not allowing fishermen to take the fish with gill nets and trot-lines. Initially, limited amounts of *S. ocellatus* by-catch were allowed by shrimp boat nets, which were incidentally caught in shrimp nets. Since shrimp nets stay down for hours the fish were generally dead when the nets were brought up. Other USsouthern states followed the Texas lead and stopped the *S. ocellatus* fishery in the Gulf of Mexico and South Atlantic.

One of the first commercial redfish hatcheries and farms in Texas was in the Rockport area, on the Stellman Ranch, encouraged by Red Ewald Fiberglass Company and Dr. Connie R. Arnold of UTMSI. Another early commercial hatchery was built by Preston Stoffer in Port O'Connor. These are photos of the elevated hatchery under construction in Port O'Connor in the late 1980's:



The prices of *S. ocellatus* rose from US \$2.20/kg (US\$1.00/lb) to almost US \$8.80/kg (US\$4.00/lb), which encouraged the aquaculture development. Farm gate prices later settled and have generally followed the price of wild-caught red snapper (ranging from US \$4.20 to 5.85/kg or US\$1.90 to to 2.66/lb) until the red snapper fishery was severely limited in the Gulf. The 2004 farm gate price is US \$4.60/kg (US\$2.09/lb), with no packaging or handling charges included, and in 2008 it is about \$5.28/kg (US\$2.40/lb). In 2009 the price of red fish went up to \$2.78/lb and some producers are getting \$3.15/lb because they can offer the fish on a year-round basis, which is what the restaurants want.

The regulatory climate is still not conducive for the expansion of aquaculture in the USA, especially along the Texas coast. So most likely any expansion into red drum culture in Texas will come from existing shrimp farms that are already built and permitted by the state.

A detailed 30 page report by Treece and Adami on red drum culture in Texas and can be found in CABI's Aquaculture Compendium. Web link:

<http://www.cabi.org/compendia/ac/index.asp>. Additional fact sheets on the biology and culture of red drum can be found at the SRAC web link <http://srac.tamu.edu/>.

Similar histories have occurred for other fishes in the state such as tilapia, bait fish such as golden shiners and mud minnows, hybrid striped bass and ornamentals. Aquatic plant nurseries and water gardens also make up a very important part of the state's aquaculture industry and have a long history in the roots of Texas aquaculture. Aquatic weed control was one topic covered in the 1968 conference and a number of companies now exist in Texas that provide this service to the community.

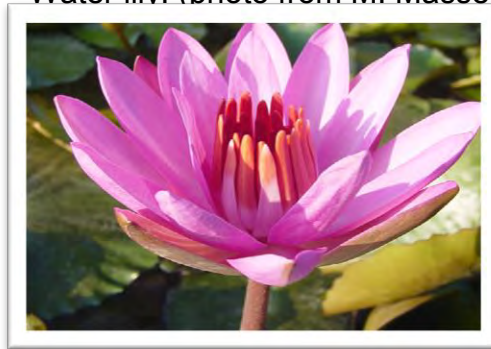
The latest USDA aquaculture census of 2009 with 2007 data found 27 ornamental fish farms in Texas, producing US\$892,000 worth of fish yearly. According to Brian Brawner of R&B Aquatic Distribution, Inc., Boerne, Texas, 15 of those commercial 'Ornamental' producers in the state operate on an estimated 40 acres and there are also over 100 garage or small shop producers. There are approximately 530 retail shops and 20 wholesalers whom handle tropical fish, not counting Walmart stores and other large chains that handle aquarium fish (Livebearers – platies, guppies, swordtails, mollies, etc., and Egg-layers – gouramis, danids, barbs, tetras, cichlids, etc.). Standard production ponds for tropicals are 80 ft. X 20 ft. X 5 ft. deep. Koi and goldfish ponds are often larger. For what would be called "coldwater ornamentals" which would include koi, goldfish, longfinned koi, white clouds, rudd, tench, crucians, sturgeons, etc. and exclude "tropicals", the market is primarily, ultimately, homeowners. Homeowners with landscaped yards and fish ponds and those fish are generally sold through retailers, like Burt Nicol's Water Garden Gems in Marion, Texas, or even provided by the companies doing the landscape work. Burt is just a retailer,



so he purchases his fish from a producer at wholesale and holds them until they sell retail. The intermediate market is the local koi shop, garden center, fish shop, water garden store, etc. According to Brett Rowley, "Walmart, Petsmart, PETCO, and other chains are pretty much out of reach to the average US producer, especially the Texas producers. Mainly because those operations buy from the lowest bidder, usually China, Israel, SE Asia, Costa Rica, Colombia, and are notoriously slow in paying and they are a distribution nightmare (10 fish per store times 3000 stores)." Rowley also says, "There are price lists circulated for the species. There are wholesale price lists for the various wild caught ornamentals from Colombian jungles. Koi can sell for around \$0.20 or so and up. Some years back, 4" pond koi were selling at US farms for around \$2.25 each (wholesale). Now the same fish brings about \$0.35 or so. So Chinese and other foreign competition has brought the farm gate prices down considerably and the producers must be able to adjust accordingly. To high-end dealers, some producers in Texas are able to sell koi (8 to 10 inches in size) for as much as \$150 each, but there are very few of these sales made according to sources in the industry."

Aquatic Plant nurseries and Water Gardens (retail outlets) make up a very large portion of the aquaculture industry in Texas.

Water lily. (photo from M. Masser)



It is estimated that about one of every 100 homes in the USA has a water garden. Water garden design and landscaping is a growing industry in Texas. The water garden industry in Texas is estimated to generate 7 million dollars a year in sales. There seems to be room for growth in most if not all segments of the industry (pond construction and set-up, fish production, plant production and retail sales).



Recirculating raceways was one topic addressed in the 1975 conference and R&D still continues in this area. Even some very exotic species were the topics of the organization meetings (grass carp and Chinese waterchestnuts). The Texas Aquaculture Association has long supported the aquaculture industry in the state, and there are now 180 aquaculture operations licensed by TDA in the state. A current list of TAA company members and a list of all aquaculture operations in the state is presented at the end of this album.

### **Aquaculture Education, Tours of Texas Aquaculture Facilities and TAA Conferences and Trade Shows**

TAA has always tried to educate the public about aquaculture and generally offers tours of producing facilities and R&D facilities at their annual conference. Additionally TAMU, UT, and Texas Parks and Wildlife, as well as Texas farm owners have always assisted with aquaculture educational efforts. TAA also holds its annual conference so that members and the public can network and catch up on the latest news, information and techniques in the industry.

Texas State Technical College (TSTC) offered an aquaculture curriculum for a number of years at the Palacios facility, but ponds have been filled and the curriculum is no longer offered since Dr. David Hinney retired. Erwin Janzen offered High School Teacher summer workshops in aquaculture at the Palacios Marine Education Center for a number of years with funding from USDA and the National Educational Council, but does not offer those training opportunities any longer. TAA has long-relied upon its state Universities for support, and Texas A&M University has long been a strong supporter of TAA.



TAMU Marine Advisory Service Seafood Quality and Safety Mobile Lab was in service on the coast from 1982 to 1988.

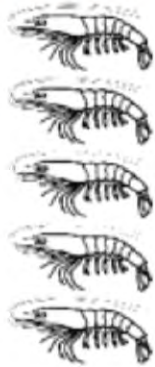


TAMU's RV Karma docked at the T-Head pier in Corpus offers marine science educational opportunities to area schools



RV Katy is a marine educational vesicle operated by UTMSI, Port Aransas.

# TEXAS SHRIMP FARMING SHORT COURSE



September 15-22, 2004  
Port Aransas, Texas

## PRESENTED BY:



### Sea Grant College Program

Sea Grant is a partnership of university, government and industry, focusing on marine research, education and advisory services. The Sea Grant concept is a practical, broad-based scientific effort to better the world for all those living in and out of the sea. Texas Sea Grant is part of the Texas A&M University System.



### Texas Cooperative Extension and Texas Agricultural Experiment Station

The mission of the Texas Cooperative Extension and the Texas Agricultural Experiment Station is to develop research-based educational programs designed to meet the changing needs of the people of Texas. TCE and TAES are both part of The Texas A&M University System.



### Marine Science Institute

The Marine Science Institute of The University of Texas at Austin was established in Port Aransas to provide strong, coordinated research and teaching programs in ocean, estuarine and earth sciences. It provides an outlet to the Gulf of Mexico for research and teaching programs, and has a world class mariculture laboratory.





1<sup>st</sup> Annual Texas Shrimp Farming Short Course, Sept. 1986. UTMSI, Port Aransas.



2<sup>nd</sup> Annual Texas Shrimp Farming Short Course, Sept. 1987. Port Aransas.





Robert Adami and other TPWD personnel provide educational opportunities on catching brood red fish to Dr. Lee from Hawaii's Tropical Aquaculture Research Center, as well as others on a tour of the TPWD/CCA hatchery in Flour Bluff.

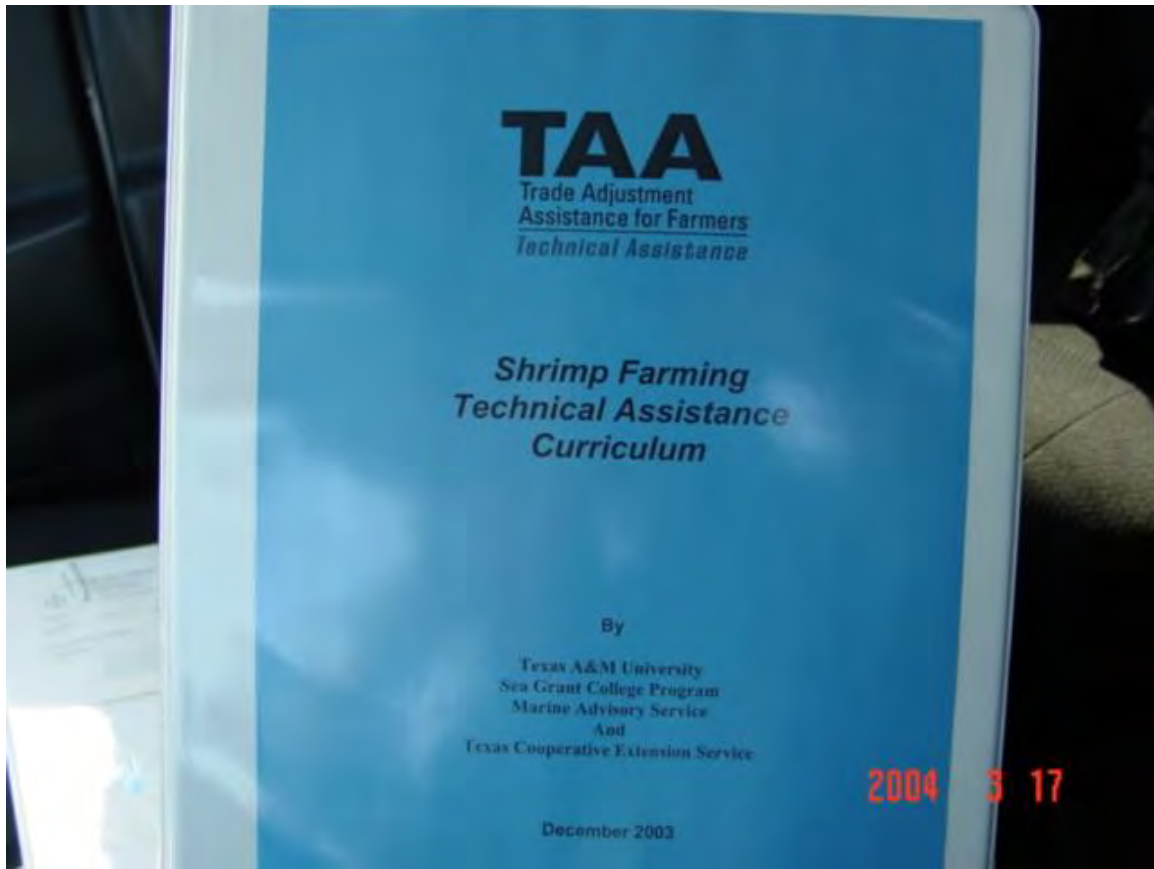




Dr. Ya-Sheng Juan conducting a tour of Ocean Venture's Wolf Point Shrimp Farm at Olivia in 1987.



Mike Hooper (Plant Manager) conducts a tour of the Bowers Shrimp Processing Plant in Palacios



Trade Adjustment Assistance for Farmers was a USDA program in 2004 and the training was conducted by the Sea Grant Extension Program and the Texas AgriLife Extension Service.





Tour, Bowers Plant



Bowers plant, spot check box weights





Bowers Plant, catfish IQF line.



Bowers Plant. 20 lb. shrimp boxes,



Bowers shrimp cold storage



Dr. Tzachi Samocha conducting a tour of the Texas AgriLife Research Station in Flour Bluff.





Dr. Frank Castille, TAMU, (retired) conducting a tour of the TAMU Shrimp Mariculture Lab in Port Aransas.



Shrimp Course Port Aransas 1991





Tour Tex-Mex Shrimp Processing Plant, Brownsville, 1995 Shrimp Farming Course.



Granvil Treece (TAMU aquaculture specialist) presents a certificate of completion to a participant of the 21<sup>st</sup> Annual Texas Shrimp and Marine Finfish Culture Course at the UTMSI laboratory in Port Aransas, Sept. 2006.



21<sup>st</sup> Annual Shrimp and Finfish Culture Course Participants in 2006. UTMSI laboratory Port Aransas, Texas



Harold Bowers conducting a tour of Bowers Shrimp Farm at Collegeport, Sept. 2006.







Tour Ronnie and Matt Benner's Lighthouse Seafood in Palacios





Tour David Tucker's T4 Farm in Imperial 2001.



Texas Aquaculture Educational Poster exhibited at TAA 2005, WAS 2007 in San Antonio and in WAS Bali 2007, where it was so popular that it was stolen from the WAS display of posters.



Tour Bowers Shrimp Plant, Palacios







Tour TAMU's (Dr. Addison Lawrence's) Shrimp nutrition lab in Port Aransas



Tour Lawrence's Lab, shrimp farming course 2004.





Tour South Texas Processors in San Benito (Tony Reisinger, tour guide)



Fish donation and transfer between Lone Star Aquafarms and TPWD, Palacios.



TPWD fish haulers took 30,000 red drum from Lone Star Aquafarms to stock several recreational fishing lakes around the state.



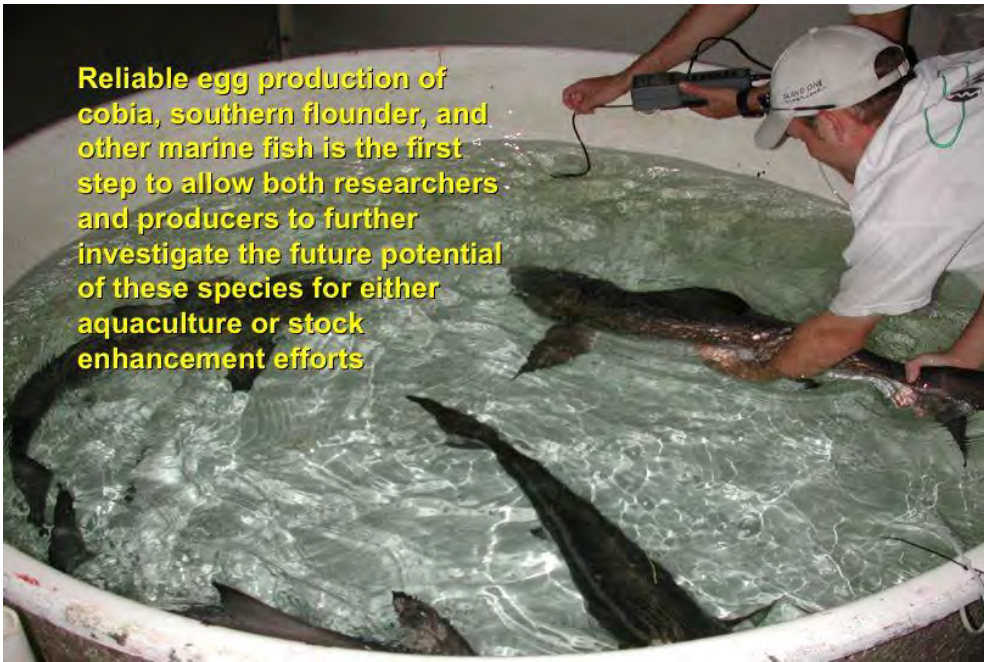


Tour David Tucker's T4 Farm and Ronnie Benners's Regal Farms in Imperial, Texas





Fish transfer at Lonestar Aquafarms in Palacios



Reliable egg production of cobia, southern flounder, and other marine fish is the first step to allow both researchers and producers to further investigate the future potential of these species for either aquaculture or stock enhancement efforts

Marine finfish research at Fisheries and Mariculture Lab, Port Aransas



Tour Tex-Mex Processing in Brownsville





TAA trade show at Lone Star Ballroom, TAMU-CC, 2005





Raffle items at the TAA Conference 2005.



Long-time vendors and TAA supporters (Cargill Feeds) at the TAA trade show 2005 TAMU-CC (David Hines showing off his writing skills...)



TAMU-CC Lone Star Ballroom (site of the 2005 TAA conference)





TAA Conference Technical Sessions





**TAA** Board meeting 2005 (TAMU-CC), at the head of the table, with their backs to the camera were Harrell Arms and Bob Waldrop. Also in attendance was Dr. Gary Jensen, USDA National Program Aquaculture Leader. Not totally hidden with their hands on their faces are Vance S. and Fritz J., and even Malcolm J. with his best side to the camera.





Rob Schmid, Tim Moore and Paul Dorsett at TAA President's Reception 2005

(Tim Moore served as TAA President in 1992 and as an aquaculture liaison for TAA in Austin. TAA is very appreciative of his past service to the industry)

Rob Schmid served as TAA President in 2005-2006 and Paul Dorsett served as TAA President in 2007-2008.



Display of aquaculture equipment outside at TAMU-CC and the TAA trade show of 2005



TAA tour by Dr. Joan Holt F.A.M.L. lab Port Aransas, 2005





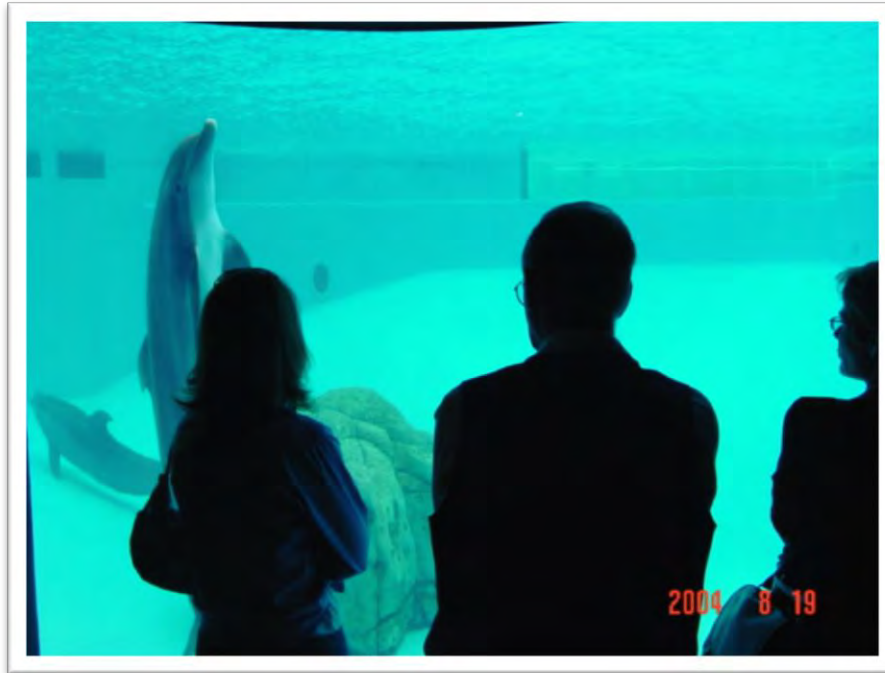
TAA tour by Dr. Tzachi Samocha, Texas AgriLife Research Station, Flour Bluff, 2005



Tour Arroyo Aquaculture Assoc. 2003







August 2004 pre-scouting tour for 2005 TAA banquet at Texas State Aquarium in Corpus Christi (Donna Hanson and Cindy Schmid viewing a potential TAA member, sponsor or vendor...)



**Texas State Aquarium, Corpus Christi** (site of the 2005 TAA banquet)







Tex-Mex Processing tour with Tony Reisinger





3<sup>rd</sup> Annual Texas Shrimp Farming Short Course, Sept. 1988. Port Aransas.



Awards presentation at Texas Shrimp Farming Course, 1990



Tony Reisinger conducting tour in 1990.



24<sup>th</sup> Annual Texas Shrimp and Marine Finfish Culture Short Course Participants,  
Sept. 30 – Oct. 6, 2009, UTMSI Port Aransas

## Texas Aquaculture Association Company Membership 2008

Company	Address	City	St.	Zip	Phone	Fax	Email
Aerators of Texas	P.O. Box 431	Markham	TX	77456	979-843-5535		
Aerway Mfg. Co	1677 Deer Brook Road	Macon	MS	39341	662-726-4246	662-726-9148	aerwaypaddles@aol.com
Air Liquide	18222 E. Petroleum Dr.	Baton Rouge	LA	70809	225-485-1512	225-754-0670	tara.etheredge@airliquide.com
Aqua Streamer	22402 Vobe Ct.	Katy	TX	77449	281-235-8152		bryanboudreaux@aol.co
Aqualine AS	P.O. Box 19497	Houston	TX	77224	281-597-1620	281-870-8041	jhendrix1706@aol.com
Arms Bait Co. and Fish Farm Inc.	2020 FM 1476	Dublin	TX	76446	254-879-2797	254-879-3251	armsfishfarm@itexas.net
Bait Barn Fisheries	2704 Hwy 21 e	Bryan	TX	77803	800-845-3534		info@baitbarnfisheries.bigstep.com
Bentoli AgriNutrition	5812 Trade Center Dr. #200	Austin	TX	78744	512-386-7333	512-386-7377	eddy@bentoli.com
Booth Ahrens & Werkenthin, PC	515 Congress Ave., #1515	Austin	TX	78701	512-472-3263	512-473-2609	fbw@baw.com
Bowers Shrimp Farm	247-81 SH 35S	Palacios	TX	77465	361-972-2414	361-972-2422	reed@bowershrimp.com
Brenham Fisheries	6257 Hwy 36N	Brenham	TX	77833	979-836-5471	979-836-0971	mrobison@hisurfer.net
Brett's Fish Farm	P.O. Box 261	Liverpool	TX	77577	281-685-6073		brett3@ix.netcom.com
Burriss Aquaculture	1012 Pearl Street	Franklinton	LA	70438	985-335-6406	985-796-5464	willie_core@cargill.com
Cain Fish Farm	P.O. Box 967	McCrary	AR	72101			
Cargill Animal Nutrition	P.O. Box 290	Guy	TX	77444	979-345-6847		david_hines@cargill.com
Conroe ISD	12605 Brontton Ct.	Montgomery	TX	77356	832-443-5843		abateman@conroeisd.net
Danbury Fish Farms	P.O. Box 528	Danbury	TX	77534	979-922-8414	979-922-1519	
Deer Park ISD	204 Ivy Deer Park	TX	71536	832-668-7151	281-930-4833		dberrier@dpsid.org
DelStar Technologies, Inc	220 E. St. Elmo Rd.	Austin	TX	78745	512-447-7000	512-447-7444	info@delstarinc.com
Dickson Brothers, Inc	204 N. Galloway	Mesquite	TX	75149	972-288-7537	972-288-7536	DicksonBro@aol.com
First Ag. Credit	Bay City 2013 Ave. C	Bay City	TX	77414	979-245-4828	979-245-6469	rbain@agmoney.com
Fish Tails	31920 Parkway	Magnolia	TX	77354	281-356-1926		
Foust Marketing, Inc.	P.O. Box 7413	The Woodlands	TX	77387	281-296-2500	281-296-2566	bryan@foustmarketing.com
H&S Farms	Route 2, Box 132-C	El Campo	TX	77437	979-637-1143		cholub@laward.net
Harlingen Shrimp Farms, Ltd	44099 Schafer Road	Los Fresnos	TX	78566	956-233-5723	956-233-9779	fritz.jaenike@gmail.com
Herrmann Fish Farm	4977 CR 83	Robstown	TX	78380	361-387-7819	361-767-3474	Herrmannsfish@aol.com
Hlavinka Equipmnet co.	P.O. Box 1335	East Bernard	TX	77435	979-335-7528	979-225-4072	hlavinka@hlavinka.com
Hula Farms Inc	1901Sims Ave	Bay City	TX	77414	979-244-2661	979-245-7225	patsyhue@ev1.net
Hurricane Lake & Fountain, Inc	1901 Magnolia Drive	Pasadena	TX	77503	713-475-2873	713-477-6594	mikep@hurricanelake.com
Instructional Materials Service	MS 2588, TAMU College Station	TX	77843	2589879-845-6658	979-845-6608		j-dettling@tamu.edu
International Filter Solutions	13636 W. IH-10	Marion	TX	78124	830-914-4404	830-914-4424	chris@ifsolutions.us
Jackson Electric Cooperative, Inc.	P.O. Box 1189	Edna	TX	77957	361-782-7193	361-782-3252	
JK Aquafarms	4608 FM 1163	Road El Campo	TX	77437	979-543-0243	979-578-0522	
Johnson Lake Management	310 Deerwood Drive	San Marcos	TX	78666	512-396-1231	512-396-5797	



**There are currently 180 licensed aquaculture producers in the state:**

**Licensed Texas Aquaculture Facilities As of 11/2009**

<b>Facility Name</b>	<b>Physical Address</b>	<b>City</b>
JOHN C RHYNE	2232 MONROE	PORT O'CONNOR
ADVANCED MARINE HATCHERIES LLC	500 INDUSTRIAL DR	PORT ISABEL
ALL ABOUT FUN HOBBIES AND GAMES	415 N MAIN ST STE 105	EULESS
AQUA FARMS OF TEXAS	RR 2 BOX 103B	EL CAMPO
AQUA TECH SHRIMP FARM	22038 PELICAN EDGE	SAN ANTONIO
AQUACULTURE AND MORE LLC	7711 SHINY TOP RANCH LN	SALADO
AQUACULTURE FARM	7201 A RICE DR	TEXAS CITY
AQUACULTURE OF TEXAS INC	4141 E IH 20 SERVICE RD N	WEATHERFORD
AQUAPONICS AND EARTH SUSTAINABLE LIVING INC	314 W BELTLINE RD	DESOTO
ARMS BAIT CO AND FISH FARM INC	RR 2 BOX 115	DUBLIN
ARROYO AQUACULTURE ASSOCIATION	36386 MARSHALL HUTTS RD	RIO HONDO
AUSTWELL AQUA FARM INC	FM 2040 S OF AUSTWELL	AUSTWELL
BIERI FARMS	CO RD 210	ANGLETON
BILLY C CAIN	CR 448	GAINESVILLE
BOLLINGER LYLE	3890 DACY LN	KYLE
BOWERS FISH FARM	HC 62 BOX 93	EL CAMPO
BOWERS SHRIMP FARM	COCKBURN RD	COLLEGEPORT
BRENHAM FISHERIES	6257 HWY 36 N	BRENHAM

BRENHAM I S D	525 A H EHRIG DR	BRENHAM
BRYCE STEPHEN KING	2172 CR 4778	WINNSBORO
BUCKS UNLIMITED INC	7243 FM 943	LIVINGSTON
C AND J FISH FARM	HWY 35 SOUTH	PORT LAVACA
CAPOTE FISH FARM	1975 SAGEBIEL RD	SEGUIN
CARTER'S FISH FARM	RR 2 BOX 388	BOYD
CATFISH CORNER	1702 LAWSON RD	MESQUITE
CHARLIE'S FISH BAIT AND TACKLE/FISHERMANS CHOICE	7961 TELEGRAPH RD	QUINLAN
CHARLIES FISH BAIT AND TACKLE	RR 2	EASTLAND
CHASE HOLUB	1930 CR 411	EL MATON
CHUANG'S INTERNATIONAL DEVELOPMENT INC	35775 MARSHALL HUTTS RD	RIO HONDO
CIRCLE W CATFISH FARM	24753 CR 448	VAN
CLEAR FORK KOI FARM	150 TOTO RD	WEATHERFORD
COTULLA FISH HATCHERY LLC	1531 S MAIN ST	COTULLA
COW BAYOU FISH FARM		ORANGE
CRAWFISH FARM, THE	CO RD 426	DANEVANG
D & R FISH FARM	3686 REHBURY RD	BURTON
D AND D CATFISH FARM	23470 FM 2767 E	KILGORE
D AND G GROWERS	2875 N HWY 281	HAMILTON
DANBURY FISH FARMS	14811 COUNTY ROAD 171	DANBURY
DANCE A TOON CATFISH	RR 6 BOX 380A	CLARKSVILLE
DANIEL E ESTES III	4545 CR 358	PALACIOS
DANNY HAM'S CATFISH FARM	FM 225 N OF CUSHING	CUSHING
DAVID SCHMIDT FISH FARM	374 CR 466 RD	EL CAMPO

DENNIS SHRIMP FARM INC	35417 MARSHALL HUTTS RD	RIO HONDO
DIEZ PATOS LTD	CR 210 5 MI N OF CR 208	LIVERPOOL
DOGUET'S CRAWFISH FARM	16939 HWY 90	BEAUMONT
DOGUET'S CRAWFISH FARM	16939 HWY 90	BEAUMONT
DOUBLE T FISH FARMS	RT 3 COUNTY RD 422	SEMINOLE
DOX AQUACULTURE	8803 CR 198	ALVIN
DUB ROLAND'S FARM POND MANAGEMENT	2869 ROLAND RD	WHITESBORO
DUNN'S FISH FARM	9 MILES NORTH OF WHITESBORO ON	GORDONVILLE
E R W INC	3MI SW OF COMANCHE	COMANCHE
EAGLES NEST PRESERVE LLC	10271 STAWAY RANCH RD	MURCHISON
EARL E SCHMIDT AND SONS	HC 62 BOX 136	EL CAMPO
EATEX FISHERIES	12505 WILD ONION RD	ORE CITY
EL MATON FISH FARMS	2614 FM 459	PALACIOS
FISH TAILS	31920 PARKWAY ST	MAGNOLIA
FISH TRADERS OF TEXAS	2655 HWY 77 S	WAXAHACHIE
FISHING HOLE INC	37782 FM 529	BROOKSHIRE
GALVESTON BAY AQUACULTURE	111 PELICAN ISLAND CAUSEWAY	GALVESTON
GREEN LAKE FISHERIES	13814 HWY 35 S	PORT LAVACA
GREENBRANCH FISH FARM AND BAIT STORE	9469 STEEPHOLLOW RD	BRYAN
GULF MARINE INSTITUTE OF TECHNOLOGY MARICULTURE	610 LEASE 860161	MATAGORDA
H AND H FARM'S	6907 W HWY 7	POLLOK
HANNA LEIGH FARM	4543 DOSS RD #D2	AUSTIN

HANSEN FARMS	FM 521	PALACIOS
HARLINGEN SHRIMP FARMS	FM 2925	ARROYO CITY
HARLINGEN SHRIMP FARMS LTD	44099 SCHAFFER RD	LOS FRESNOS
HEARD FARMS	1/4 MI W OF CITY ON HWY 616 S	FRANCITAS
HEB #061	4001 N LAMAR BLVD	AUSTIN
HERRMANN FISH FARM	4977 CR 83	ROBSTOWN
HONG KONG SUPER MARKET	8557 RESEARCH BLVD STE 130	AUSTIN
HOUSTON FACILITY	1118 SMALLWOOD LN	HOUSTON
HUFFSMITH FISH FARM	16261 C GUEDRY RD	BATSON
HULA FARMS INC	5090 CR 414	MARKHAM
HURRICANE LAKE AND FOUNTAIN	1901 A MAGNOLIA DR	PASADENA
IPES CATFISH FARM	INT OF FM 2626 AND LEESMILL RD	NEWTON
J K AQUAFARMS	4608 FM 1163	EL CAMPO
J R ENTERPRISES	5090 CR 414	MARKHAM
JACKSON BROTHERS FEED	3818 STREDAWAY	ABILENE
JERRON'S FISHING HOLE	RR 6 BOX 550	PARIS
JOHN C RHYNE	5929 HWY 185	PORT O'CONNOR
JOHN LEITA CATFISH FARM	534 LEITA RD	INEZ
JOHNNIE CARROLL FISH FARMS	1071 CR 385	PALACIOS
JOHNSON LAKE MANAGEMENT SERVICE	310 DEERWOOD DR	SAN MARCOS
JR'S AQUACULTURE FARM INC	2320 FM 3280	PALACIOS
K G HALE	219 N VAN BUREN ST	HENDERSON
KOI RANCH	RR 11 BOX 44-HEATH LN	JACKSONVILLE
KAMEY KATFISH	372 KAMEY RD	PORT LAVACA



KELLY J BROYLES	RR 4 BOX 107B	SULPHUR SPRINGS
KELLY L WIMBISH	614 CR 4165	CRANFILLS GAP
KENNETH HENNEKE HUMPBACK BLUE CATFISH	1267 CR 134	HALLETTSVILLE
KEVIN'S GAME FISH	4745 REDBIRD ST	PORT ARTHUR
KURTIS D KOOP	1606 CR 110	EDNA
LABATT FISH FARM	5254 US HWY 181 N	FLORESVILLE
LAKES OF DANBURY	14302 CR 602	DANBURY
LARRY'S FISH FARM	4203 N HWY 77	GIDDINGS
LAURA JOANN	136 A RIVER RANCH RD	BOERNE
LECOMPTELAKES	1635 LAKE	DANBURY
LICATINO FARMS	3 MI S OF HWY 73 ON BIG HILL R	PORT ARTHUR
LOCHOW RANCH	4700 CR 342	MILANO
LONE STAR AQUACULTURE	2126 HAMILTON DR #240	ARGYLE
LONE WOLF FARMS	138 WOODS	YORKTOWN
LONESTAR AQUAFARMS LTD	1014 JACKSON CR 477	PALACIOS
LONG HORN FISH FARM	9244 TEN MILE BRIDGE RD	FORT WORTH
MARK KUBECKA FARMS	CRD 327	PALACIOS
MENGERS AND SONS FARM	1.5 MI N OF TYNAN	TYNAN
MICHAEL J SAHA JR	1 MI E OF FM 1095 ON CR 357	PALACIOS
MICHAEL SHRIMP FARM	35815 MARSHALL HUTTS RD	RIO HONDO
MR FISH	16914 CR 210	DANBURY
NATURALSHRIMP HEADQUARTERS	833 CR 583	LA COSTE

OAKHURST BAIT COMPANY	1131 HWY 190	OAKHURST
OVERTON FISHERIES	19367 IH 45 S	BUFFALO
PALACIOS FACILITY	5165 CR 324	PALACIOS
PATRICK J HICKL	3743 CR 411	ELMATON
PERMIAN SEA ORGANICS	1 MI E ON FM 11 N SIDE OF RD	IMPERIAL
PETROPHYSH AQUACULTURE CONSULTING	1635 LAKE	DANBURY
PETROPHYSH AQUACULTURE CONSULTING	27435 MORTON RD	KATY
PHALBA PHISH PHARM INC	HWY 198 AT CR 2410	CANTON
PIECES 153	13935 HWY 87 S	SHELBYVILLE
R AND G SHRIMP COMPANY	SEE ATTACHED MAP	PORT LAVACA
R AND R FARMS	CR 391 ROBBINS SLOUGH RD	PALACIOS
R SCOTT ENTERPRISES INC	2574 FM 1343	DEVINE
RED DEER PARK INC	830 BURNETT ST	MIAMI
RICHARD DOSS	1611 VAN ZANDT CR 1509	GRAND SALINE
ROBERT LEHMANN	610 GIESE LN	WARDA
ROBERT MAREK	2860 FARIK RD	PORT LAVACA
ROQUE FARMS	145 HWY 489	OAKWOOD
ROSENBERG FISHING FARM	202 DAILY RD	ROSENBERG
SAHA FISH FARM	2895 CR 391	PALACIOS
SAHA FISH FARM	2895 CR 391	PALACIOS
SAN TUNG INC	35417 MARSHALL HUTTS RD	RIO HONDO
SANTA FE CATFISH FARMS	6602 BAR O RANCH RD	SANTA FE
SCOTT A GILLIAM	2317 CLARK DR	LA MARQUE

SEASIDE AQUACULTURE	FM 3280 WELL POINT RD	PALACIOS
SEASONS AQUAFARM	2217 DOWNING LN	LEANDER
SIDNEY SCHMIDT	1550 CR 408	EL CAMPO
SILVER STREAK BASS COMPANY	1205 FRANK STUBBS	EL CAMPO
SIMARON FRESH WATER FISH INC	25923 NELSON RD	HEMPSTEAD
SOUTH TEXAS CRAWFISH INC	3 MI S OF MATHIS ON FM 666	MATHIS
SOUTHEAST TEXAS CRAWFISH FARM		WINNIE
SOUTHEAST TEXAS FISHERIES	5151 FM616	BLESSING
SOUTHERN STAR INC	35518 MARSHALL HUTTS RD	RIO HONDO
SOUTHWEST AQUATIC SERVICES	3862 HWY 90A	ALTAIR
SOUTHWEST FISH HATCHERY	6122 CR 319B	TERRELL
ST ANTHONY FISH FARM LTD	1297 FM 3280	PALACIOS
ST MARTIN'S SEAFOOD	SW CORNER OF COUNTY LINE RD	PALACIOS
ST MARTIN AQUACULTURE INC	3104 FM 3280	PALACIOS
STAVEN L SCHMIDT	5714 CR 424	EL CAMPO
STEVE FRIESS	1619 RIDWOOD	MAGNOLIA
STILES FARM FOUNDATION	5700 FM 1063	THRALL
STILL WATERS FISH FARM	8621 FM 943	LIVINGSTON
SUNRISE RIDGE ALGAE TEST FARM	2210 FM 973	AUSTIN
TANK HOLLOW FISHERIES	200 W TANK HOLLOW RD	POTEET
TEXAS A&M UNIV SYS AQUACULTURAL RESEARCH	2258 TAMU	COLLEGE STATION
TEXAS A&M UNV SHRIMP MARICULTURE PROJECT	1300 PORT ST	PORT ARANSAS

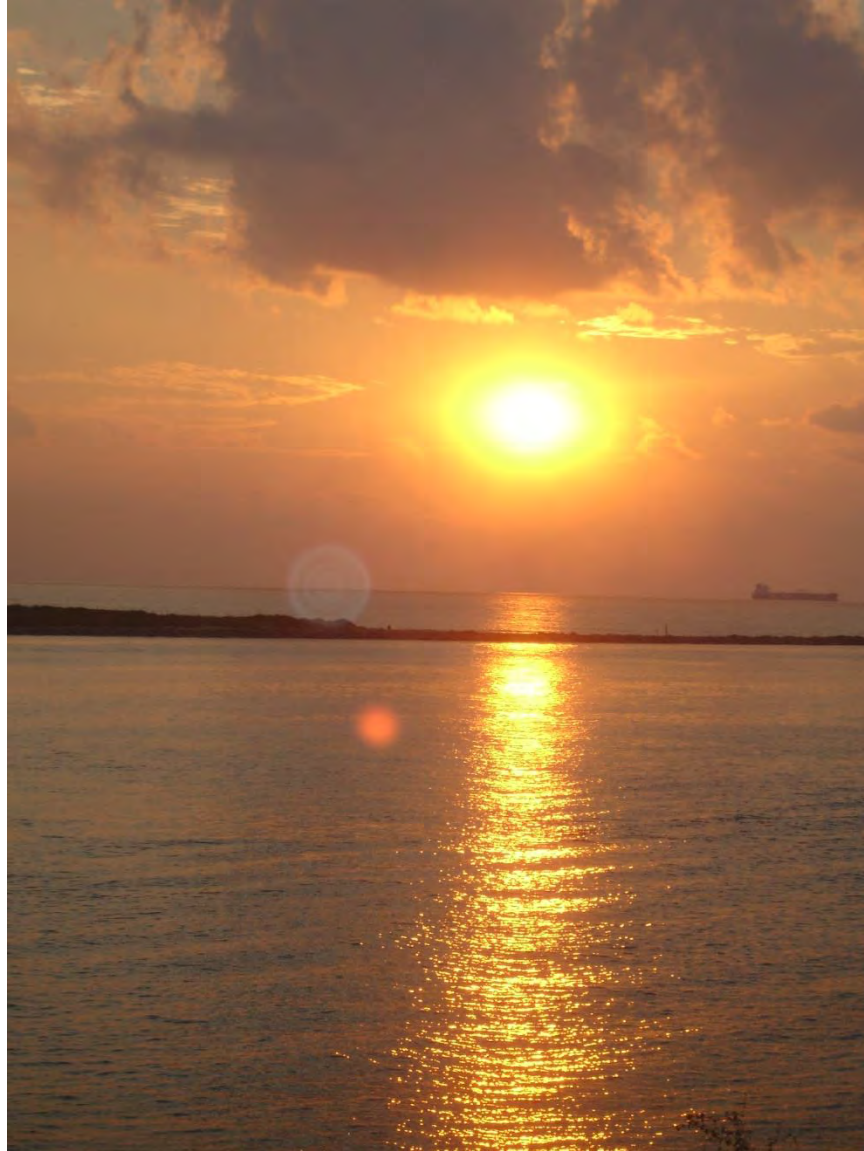
TEXAS A&M UNV SHRIMP MARICULTURE PROJECT	4301 WALDRON RD	CORPUS CHRISTI
TEXAS AQUAPONICS	553 CAMPBELL RD	MAYPEARL
TEXAS AQUATIC DISTRIBUTION	5151 HWY 616	BLESSING
THE BAIT BARN FISHERIES	2704 HWY 21 E	BRYAN
THE DIBS FOUNDATION PILOT PROJECT	3702 SPRING CT	MANVEL
TLM RANCH	2775 41ST ST SE	PARIS
TOTAL LAKE MANAGEMENT	9250 FM 2549	BRYAN
TRAN'S CATFISH FARM INC	1 MI S OF PORT LAVACA ON FM 12	PORT LAVACA
TRANS AQUACULTURE INC	CR 391	PALACIOS
TURTLE CREEK AQUACULTURE	TURTLE CREEK AND HWY 35	PALACIOS
TYLER FISH FARMS, INC.	3096 VZ CR 4923	BEN WHEELER
VICTOR AND BARBARA CORPOON	1156 CR 385	PALACIOS
VOLLMAR POND AND LAKE MANAGEMENT	201 BROADMOOR	FREDERICKSBURG
WALTER BOWERS FISH FARM	5758 FM 1095	PALACIOS
WALTERS FARM	4 1/2 MI FROM HWY 7 ON CR 202	CENTERVILLE
WAYNE J WOLFE	2 WOLFE DR	LAMPASAS
WERNISING FISH FARM	8069 CR 498	JEWETT
WHITAKER FARM JV	FISHER SMITH RD	PORT LAVACA
WHITAKER FARMS	257 HULEO RD	PORT LAVACA
WHITE FENCE INDUSTRIES	17292 FM 225 S	DOUGLASS
WICHITA FISH FARM	13173 BLAKER RD	IOWA PARK
WILLIAM W YORK	1301 S FIGRIDGE RD	STOWELL



WOMACK FISH FARM

711 NAVARRO ST

SAN ANTONIO



**Acknowledgments:**

The authors would like to thank the TAA membership for generously contributing photos for this 40<sup>th</sup> Anniversary photo album. We give special thanks to Robert Adami, Lee Bartlett, Harold and Reed Bowers, Brian Brawner, Charlie Chan, Dr. Joe Dettling, Dr. David Dunseth, Dr. Delbert Gatlin, Kieth Gregg, Dr. Joan Holt, Bing Hung, Fritz Jaenike, Jeff Kaiser, Dr. Addison Lawrence, Dr. Michael Masser, Thanh Nguyen, NOAA, Tony Reisinger, Bart Reid, Dr. Tzachi Samocha, Robert Smiley, Dr. Robert R. Stickney, Texas Dept. of Agriculture Go Texan Program, Texas General Land Office, John Turner, and Peter Woods for photos and access to facilities. We thank Vance Schultze, Lee Bartlett, Dr. Jim Davis, Dr. S.K."Ken" Johnson, and Jim Ekstrom for assistance in verifying the historical

accuracy of this album. Tanya Baker of Texas Sea Grant was the graphic artist and designed the album.



## TAA PHOTO ALBUM



Lake Fairfield redfish caught in Winter 2009 from TPWD stocking fish (some of which may have come from Lone Star Aquafarms in Palacios).



Steve Treece (of Plano) with unusually spotted Lake Fairfield red drum in winter 2009. Stocked by TPWD and may have been from fish donated from Lone Star Aquafarms in Palacios.





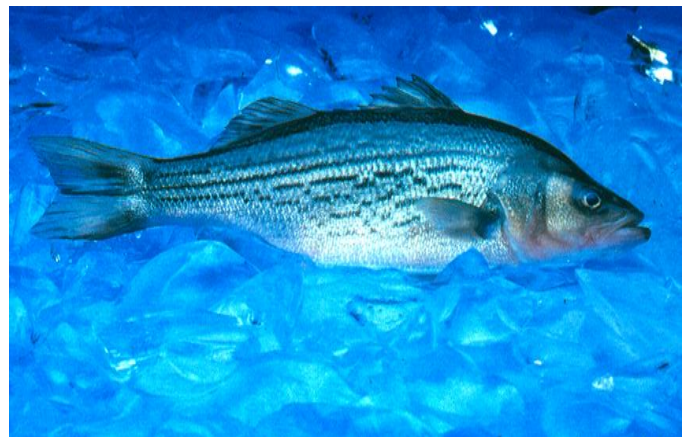
Aerial St. Martin's Seafood Partnership shrimp farm, phase I construction in Palacios. 1990s. Farm is now over 200 acres. Owned by Thanh Nguyen.



Arroyo Aquaculture Assoc.(Formerly Chung Mei) intake 1990s



979-543-8989  
info@silverstreakbass.com

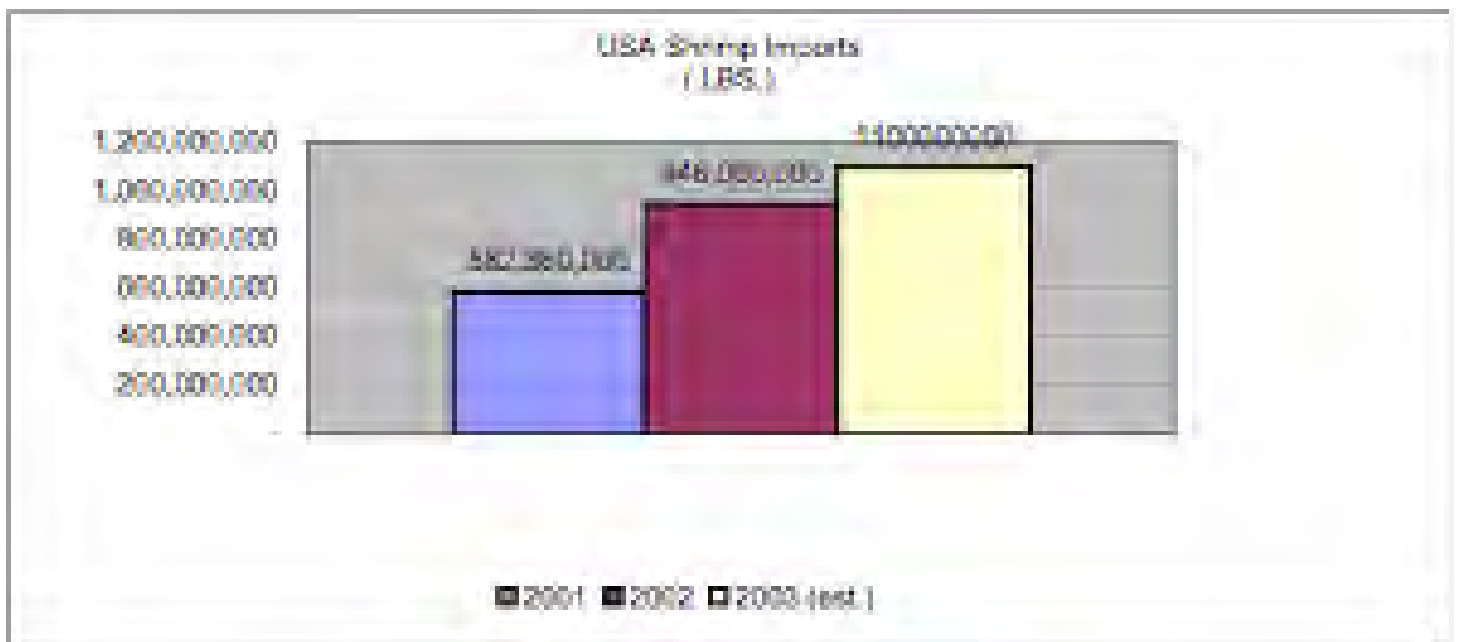






## Trends in U.S. Shrimp Imports

(Source: USDA Aquaculture Outlook)







Automated shrimp harvester at Arroyo Aquaculture Assoc.



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1482 Butcher Road \* Nacogdoches, TX. 75961



TPWD Perry R. Bass Marine Finfish Research Station, Redfish Unltd., Roark Oyster Farm and Chei Juan's GLO-leased shrimp farm in Palacios, at the end of Well Point Rd. on Matagorda Bay.



Brood shrimp in tanks at Lone Star Hatchery, Port Isabel





Phase I and Phase II, Ocean Venture's Wolf Point Shrimp Farm in Oliva (1984-1989)



Intake canal Southern Star





Nursery pond construction at Southern Star, 1990s

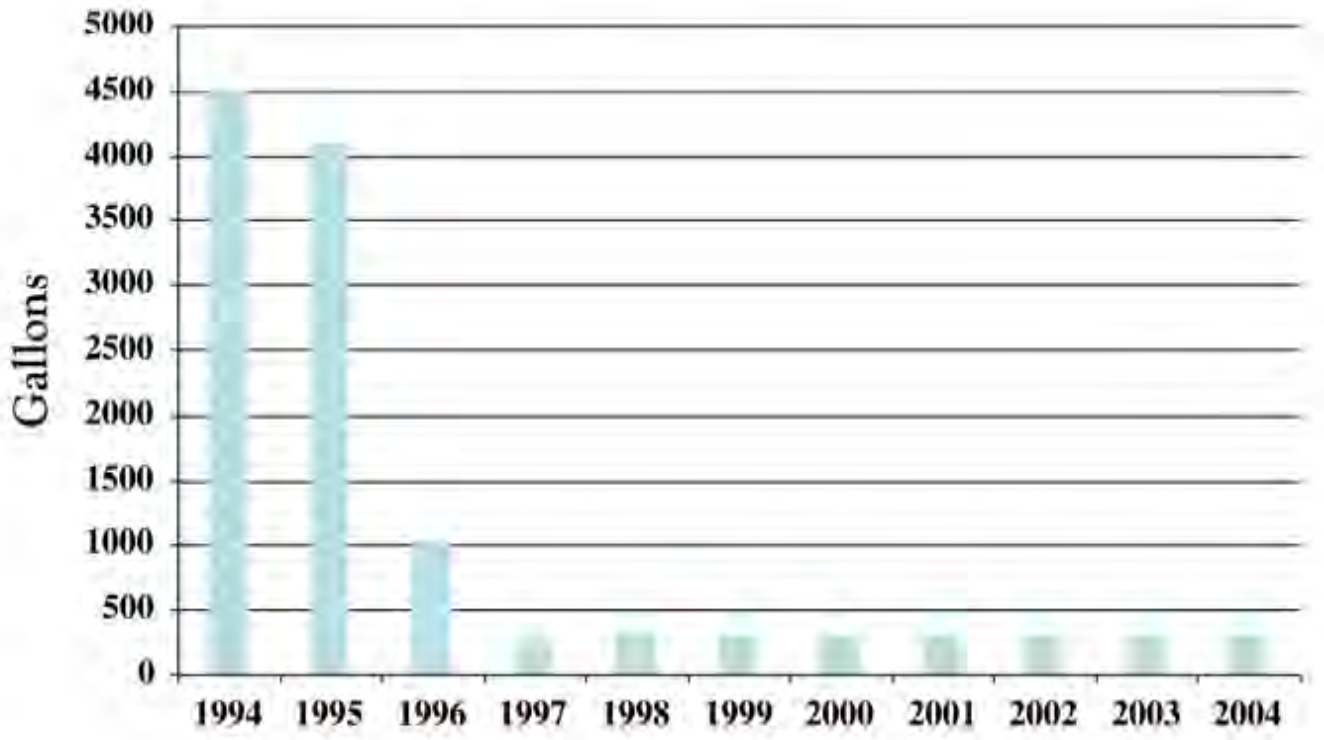


Ron Parmientier's shrimp farm in Port Lavaca. Stocking shrimp under greenhouses. Fritz Jaenike consulting. April 1991.



Created Wetland at Loma Alta, South Texas

## Gallons/ Pound



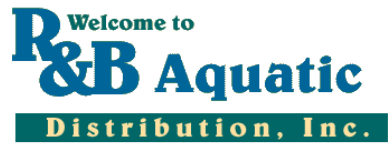




Mud minnows removed from shrimp pond harvest in West Texas.



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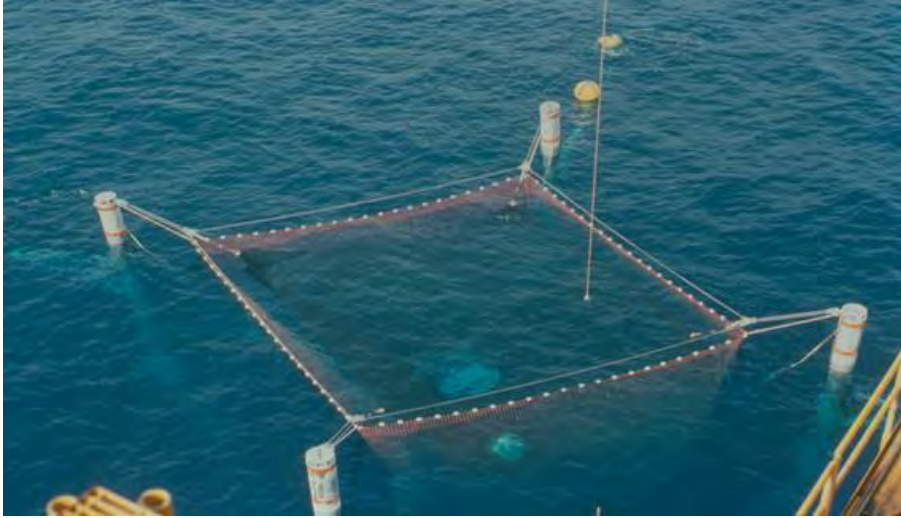


*R&M Firearms  
El Campo, TX*









Occidental Petroleum net pen R&D project 18 miles off Port Aransas. 1988-89.

A vast potential still lies offshore for future Texas aquaculture