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ASSESSMENT OF THE POTENTIAL OF THE CULTURE OF FRESHWATER SHRIMP IN PANAMA

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SUMMARY

1. The physical environment of Panama including climate, water and soil types are suitable for culturing freshwater shrimp.
2. Subsistence fisheries for native freshwater shrimp have existed in Panama for many years, however, the large, native, freshwater shrimp *Macrobrachium americanium* does not have the culture potential in pond conditions that certain non-native species possess.
3. The species of shrimp which shows the greatest potential for culture is *Macrobrachium rosenbergii*, native to Southeast Asia. This shrimp has recently been introduced to many tropical and sub-tropical countries including Panama.
4. Panama has been successful in spawning and rearing *M. rosenbergii* for several years at the GOP national fish hatchery at Divisa. The GOP presently has a small *Macrobrachium* hatchery under construction in Veracruz.
5. *M. rosenbergii* offers several advantages and disadvantages as a culture organism for Panama.
   A. Advantages
      1. Its feeding habits are such that it can be effectively cultured in fertilized ponds.
      2. It can be cultured as a single species or in polyculture with such fish as tilapia and carps which are presently being utilized in Panama.
      3. It grows rapidly, reaching a large size in 4 months, is relatively hardy and can be easily cultured by people with little or no technical background.

B. Disadvantages

1. It can not complete its life cycle in freshwater ponds and must be continuously restocked.

2. Mating and egg development occur readily in freshwater and in captivity, but proper development of larvae requires water of 12-16 ppt salinity. This requirement necessitates locating hatcheries in coastal areas.

5. Efficiency and ease of culture of freshwater shrimp are similar to other cultured species such as tilapia and carps; however, the higher market values of shrimp have the added incentive of use as a cash crop, which could contribute to improved economic status.

Recommendations

1. Continue working with M. rosenbergii at Divisa fish hatchery. While the Macrobrachium hatchery is being constructed, train existing fishery extension workers in proper methods for handling, stocking and culturing freshwater shrimp.

2. After this hatchery is operational, begin incorporating freshwater shrimp into selected existing pond systems which can be easily and accurately monitored.

3. Investigate potential markets.

4. Analyze production and catch records from different culture systems and determine economic impacts on communities.

5. Evaluate hatchery needs and distribution methods for expansion of programs.

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Introduction:

At the request of the Government of Panama (MIDA-DINAAC) and USAID/Panama, David B. Rouse traveled to Panama November 30-December 12, 1981, to assess the potential of freshwater shrimp in aquacultural development in Panama.

Background:

Rivers and streams of Panama have supported a subsistence fishery for naturally occurring freshwater or river shrimp for many years. Several species of these shrimp are native to Panama, the largest species, *Macrobrachium americanum* sometimes exceeds a pound in weight. These shrimp are usually captured with a rounded funnel trap woven from wooden slats and baited with stale meat. On several occasions during this visit young boys were observed along the highway selling shrimp.

Because of the impressive size and high market value of these shrimps, interest in their culture has existed for a number of years. A fishculture survey report for Panama by Smitherman and Moss (1970) documented some of these early efforts. In response to the interest by Panamanians to culture these shrimp, personnel at the International Center for Aquaculture at Auburn University performed studies both in Panama, and at its own experimental ponds from 1970 to 1973 to determine the shrimp's life history and potential for pond culture. Their findings indicated that, like most others of its genus,

Macrobrachium americanum grows, mates, and the eggs develop in freshwater but soon after hatching, the larval shrimp must undergo a series of developmental stages in brackishwater. It is after this developmental period that the juvenile shrimp migrate up freshwater rivers and streams to develop and grow into adults. The study also indicated that shrimp survival was low when cultured in ponds, possibly because of its cannabalistic behavior.

Elsewhere in the world during the early 1970's, interest in the culture of freshwater shrimp stimulated similar research with other species of freshwater shrimp. More than 100 species of freshwater shrimp have been identified in tropical and sub-tropical climates. A species native to Malaysia, Macrobrachium rosenbergii, has been recognized by most shrimp culturists as having the greatest potential for culture.

By the middle 1970's technology for hatcheries and pond culture had developed to levels that allowed both government and private operations to begin culture programs (Goodwin and Hanson, 1974; Singholka, 1978).

Present Activities in Culture of Freshwater Shrimp in Panama:

In addition to the small subsistence fisheries discussed earlier, the government of Panama (MIDA-DINNAAC) has maintained stocks of the Malaysian prawn Macrobrachium rosenbergii at their Divisa Fish hatchery for several years. In 1981 hatchery personnel successfully hatched and reared larval shrimp through the larvae phases for restocking hatchery research ponds. These operations were performed with meager supplies and involved hauling salt water daily from Aquadulce, about 45 minutes from the hatchery.

A grant has recently been awarded to Panama for the construction of a hatchery for freshwater shrimp. The hatchery will be located near Veracruz.

Social Considerations

The principal reason for the GOP. interest in aquaculture is to improve nutritional alternatives for the rural poor people. The need for nutritional improvement is not always recognized by the poor for its long range benefit. Short range economic improvements often have more appeal. Shrimp usually command higher prices in the markets than fish and other aquatic organisms cultured for food. Incorporation of shrimp as a cash crop into the community pond systems of Panama could provide a basis for economic development as well as the basis for nutrition improvement. An appeal to income and nutritional improvement as a reason for aquaculture may have special positive affects.

Constraints

(1) Markets

If shrimp are to be a good cash crop item from community ponds, there must be adequate markets for them. The subsistence fishery for native species yields an unknown but probably small supply of shrimp and is commonly marketed along roadsides. The culture of shrimp in ponds would increase supplies. New markets would probably need to be developed, such as restaurants and wholesalers in cities.

(2) Man-Power:

The life history of freshwater shrimp requires that larval development takes place in 1/3 strength seawater. This requirement necessitates locating hatchery facilities in coastal areas. At the time of this study a hatchery was under construction at Veracruz which will meet this requirement.

The Divisa hatchery staff has displayed ability to successfully complete hatchery operation for freshwater shrimp. However, the tremendous effort stressed by DINAAC (MIDA) in the on-going finfish project has extended available man-power and budgetary resources to maximum limits.

During the larval development stages, shrimp require almost continual attention. The 3-4 hours drive separating the Divisa hatchery from the Veracruz hatchery would prevent utilizing the same personnel simultaneously at both hatcheries. Hence, additional hatchery staff will be needed.

(3) Culture Technolgies

Before shrimp are provided to community ponds, some field testing under culture conditions in Panama is needed. The information obtained in these field tests then could be provided to extension workers who, in turn, would work closely with pond operators. Such information should include:

(1) Stocking density in various aquaculture systems used in Panama. Suggested rates would be 1-4 juvenile shrimp per square meter of pond bottom every six months.

(2) Recommended rates for any nutrient inputs that may be available in Panama such as inorganic or organic fertilizers, and agricultural byproducts.

(3) Harvesting techniques such as selective neting with seines and cast nets or by trapping with traditional methods used for native wild shrimp should be investigated.

Conclusion

The freshwater shrimp, *Macrobrachium rosenbergii*, which is presently maintained at the Divisa Fish hatchery is well suited biologically for culture in community ponds of Panama. It should grow well at Panamanian temperatures, is relatively tolerant to handling and diseases, and feeds low on the food chain, deriving its basic nutrition from primary productivity in culture ponds.

While freshwater shrimp can be easily cultured, their most attractive feature as an aquaculture organism is their high market value. Incorporation

of a cash crop into the community pond system could contribute to economic development in addition to the nutritional improvement obtained in current fish culture projects.

There are still certain questions that need to be answered regarding the most effective culture techniques and marketing strategy of cultured fresh-water shrimp in Panama. The construction of a Macrobrachium hatchery to provide seed stock is the first step. As small shrimp become available, culture methodology can be refined and potential markets explored. With this information, effective extension training and successful introduction to community ponds will be possible.

Following successful introduction of shrimp, studies of the economic impacts on the community should be implemented. The first ponds to be used should be carefully selected to insure that the best possible records can be maintained.

The potential for economic improvements from shrimp culture community ponds appears good. The success that fin fish aquaculture has achieved in Panama should provide an excellent opportunity base to study impacts that shrimp may contribute to development.

REFERENCES

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Smitherman, R. O. and D. D. Moss. 1970. Fisheries survey report for Panama. International Center for Aquaculture, Auburn University, Auburn, Alabama. 64 p.

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Appendix I

Panama
November 30 - December 12, 1981
Places Visited and Persons Contacted by D. B. Rouse

November 30, 1981	Panama City	Sr. Guillermo Walters, Sub-Director, National Aquaculture Directorate (DINAAC), MIDA, GOP
December 1, 1981	Punta Chame	Sr. Xaviea Perez, Manager Private shrimp farm
December 2, 1981	Punta Chame	Sr. Jose Abreu Corporation de Camerones private farm. Visited other private shrimp farms in area
December 3, 1981	Aquadululce	Dr. Richard Pretto, Director National Aquaculture Direccoriate Sr. Guillermo Walters, Sub-Director, National Aquaculture Directoriate Mr. W. R. More, Hatchery Manager Ralston Purina Company Agromarina de Panama Mr. Glen Beiber Ralston Purina - Research Biologist, Agromarina de Panama Sr. Ruben Espano, Manager Palangosta Shrimp Farm Chairman Shrimp Growers Assoc. of Panama
December 4, 1981	Herrera & Los Santos provinces	Dr. Len Lovshin Auburn University Aquaculture advisor to Panama visit community ponds
December 5, 1981	Santiago, Divisia	Dr. Len Lovshin Auburn University Aquaculture advisor to Panama Dr. Richard Pretto, Director National Aquaculture Directoriate
December 6, 1981 (Sun)	Santiago	

December 7, 1981	Aquadulce	Sr. Roberto Garcia Ing. Pablo Vergara Research personnel National Directorate of Aquaculture "Eng. Enrique Ensenat"
December 8, 1981	Santiago, Veraguas Province	Dr. Len Lovshin Auburn University Aquaculture Advisor to Panama visit to community ponds
December 9, 1981	Aquadulce	Sr. Roberto Garcia Ing. Pablo Vergara National Directoriate of Aquaculture La Estrella Corp. - Private Shrimp Grower
December 10, 1981	Aquadulce, Divisa	Sr. Diomedes Garcia Sr. Roberto Garcia Ing. Pablo Vergara National Directoriate of Aquaculture Divisa Fish Hatchery
December 11, 1981	Panama City, Veracruz	Mr. Franklin Kwai-Ben Agromarina de Panama, S.A. Asst. Hatchery Manager Sr. Guillermo Walters Sub-director National Directoriate of Aquaculture
December 12, 1981	Panama City	Sr. Guillermo Walters Sub-director National Directoriate of Aquaculture Construction site of *Macrobrachium* hatchery

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CULTURE OF SALTWATER SHRIMP

IN PANAMA

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Introduction

Shrimp culture in Panama began in 1974 when Agromarina, a subsidiary of Ralston Purina, began their operation with a series of experimental ponds near Aquadulce and a hatchery at Veracruz. On this visit, Agromarina had 600 ha of ponds in production and their hatchery was producing 12 million postlarvae per month. Agromarina's operation is considered by many to be the most successful shrimp culture operation in the world.

With the apparent success of Agromarina and news of the tremendous expansion of shrimp culture in Ecuador, many Panamanian companies are now getting into shrimp farming. The areas where shrimp are being cultured in Panama are located near the sea on the Pacific coast. The lands most suitable for culture are found from Panama City westward and south to the peninsula of Los Santos. These lands are called albinas and are flat lands with little vegetation, located between the coastal fringe of mangrove forest and the higher elevations covered with freshwater vegetation. Additional lands suitable for shrimp culture but at higher elevation are found in the province of Chirique near David. Estimates of total suitable acreage of albinas range from 14,000-19,600 ha. The area of suitable land at slightly higher evaluations called "tierra dulce" has not been determined.

Of the total area of albinas, some are presently used for salt production, some are in private ownership and not available for development and some have already been developed in shrimp ponds. One reliable source said that as little as 3,000 ha may actually be available for future development.

There are reported to be twelve shrimp farms operating in Panama. Although there was a large variation in pond design and culture techniques, there appears to be an effort to work together by many of the operators. In 1980, the Panamanian Association of Shrimp Producers was formed. Sr. Ruben Espanno, manager of Palangosta Shrimp farm in Aquadulce is chairman of the Association.

The national Government of Panama has also shown its support for the development of the industry. In 1979, the GOP through the National Aquaculture Directorate (DINAAC) constructed an Experimental Marine Station "Ing. Enrique Ensenat" in Aquadulce to provide research information for shrimp and other brackishwater organisms.

In December 1982, the GOP was also negotiating a loan of $12 million U.S. dollars with the Inter-American Development Bank (IDB) to further support the industry. The money would be available as low interest loans through the National Bank of Panama for shrimp farm construction and to construct a saltwater shrimp hatchery and maturation facility at Punta Chame and a combination laboratory/training facility at the Experimental Marine Station.

Present Culture Practices

There are three commercially important, white shrimps in Panama: *Penaeus occidentalis*, *P. stylirostris*, and *P. vannamei*. Shrimp farmers prefer the latter two species. The former species grows poorly in culture ponds but comprises the majority of shrimp in the commercial shrimping industry.

Shrimp ponds in Panama are usually constructed in a rectangular shape with dikes formed from soils either taken from the pond bottom or hauled in from adjacent areas. The most suitable sites are located in albina or salt flats. These albinas are lands that are inundated only during the spring or

highest tides, twice each lunar month and are usually connected to the sea by esteros or tidal creeks.

Pond bottoms are generally sloped toward a drain box or sluice gate. Pumping stations are located at or near the tidal creek and pump during daily high tides into a supply canal or reservoir. The incoming pumped water is filtered through screens in the sluice gate to eliminate predators and competitor fish. Ponds are usually arranged in a series along either side of the supply canal. There are usually drainage canals along each side of the deep end of the pond. Pond sizes range from 2-30 ha.

At least three of the new shrimp farms visited were constructed in what had once been mangrove forest. Although numberous papers have been written which document the environmental damages and the water quality problems which often occur in culture ponds as a result of this practice; the practice still occurs. This points out the need for more educational programs by marine extension agents of the DINAAC. Other shrimp farms visited, displayed excellent inovations in new pond designs and in corrective measures in older ponds.

One particular operation worth noting was owned by Sr. Xavier Perez in Punta Chame. Sr. Perez had no salina on which to construct ponds so instead of utilizing mangroves he constructed shrimp ponds in an upland area slightly above the mangroves using a stair step arrangement of ponds. He had a series of three ponds one built just below the other with each successive pond larger in size. He stocked small shrimp at $500/m^2$ in the first pond (nursery) for 45 days then released them into the next two ponds each for 45 days. The system was new and had not been fully tested but has an estimated production of 700 lbs (heads on) ha/45 days. A design similar to this had been very recently studied in Texas but had yet to be tested on a large scale. All shrimp growers, with the exception of Agromarina, must catch their seed stock from the

wild. After the highest tides of each lunar cycle, waters are trapped in natural ponds in the albinas. These small shrimp are then harvested with small mesh nets and taken to the farms. The abundance of small shrimp is seasonal with the largest numbers occurring during the dry season between December and May.

Nursery ponds are used by some growers. Stocking rates vary depending on management techniques. If supplemental feeds are added, a stocking rate of 75-150 post larval shrimp/m^2 may be used. If no additional feed is added to the pond, stocking rates of 25-50 shrimp/m^2 may be used. After 45-50 days in the nursery ponds, juvenile shrimp of 1-1.5 g are transferred to growout ponds. Stocking rates of juveniles are again dependant on management techniques. Some growers add very little additional nutrients and may only stock 1-2 shrimp/m^2 of pond area. Other growers may stock up to 4 or 5 shrimp/m^2 and add supplemental feeds.

The length of culture for each crop varies depending on climatic conditions and management techniques but usually ranges from 120-150 days. Production varies from 700 kg/ha/yr for some extensive operations to 2500 kg/ ha/yr for the more intensively managed operations.

There are presently two companies producing and selling shrimp feeds in Panama. Both companies use essentially the same ingredients and method of fabrication, ingredients and their final products are similar. They make a pellet of about 25% protein using fish meal as the primary protein constituent. Vitamins and ground whole grain are also a part of the formula. These pellets dissolve quickly in water and the particle size of the grain is large. These feeds might be graded average to poor in quality.

Harvesting as practiced in Panama is relatively simple. The pond water level is drawn down for several days before the harvest until only 25-30 cm of

water covers the bottom. A net is placed over the outlet side of the drain pipe. The remaining water and shrimp pass out of the pond and into the net. The water passes through the net while the shrimp are collected. The shrimp are usually placed in ice water on the pond bank immedately after harvest at which time the shrimp are transported to an area for deheading; they are then placed on ice again and sent to a processing plant.