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AQUACULTURAL DEVELOPMENTS IN PERU

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RECOMMENDATIONS

In view of the increased need for development of inland fisheries in Peru and continuing interest in aquaculture as evidenced by the Ministry of Fisheries and the private sector, it is recommended that:

1. The Ministry of Fisheries should proceed with plans to construct a warmwater aquacultural research center with a sufficient number of experimental ponds so that improved methods of fish culture can be developed rapidly. In addition to experimental ponds, a number of small hatchery ponds for fingerling production and larger ponds for production of food fish should be constructed to serve for extension and demonstration purposes.

Approximately 100 experimental earthen ponds will be needed, each with a water surface area of 0.1 hectare. Ponds should be constructed so that each can be filled and drained individually.

2. A special two-week training program be carried out in Peru in early 1973 by a team of three professors from the International Center for Aquaculture, Auburn University. It is suggested that this program, to be cooperatively sponsored by the Ministry of Fisheries and U.S.A. I.D./Peru, will be of great benefit to many biologists and other personnel of the Ministry. Composition of the training

team will be determined through selection of subject matter areas deemed by the Ministry to be most important for its biologists.

3. A minimum of two scholarships per year for three consecutive years (6 in total) be made available to selected personnel of the Ministry. Scholarships for advanced studies (Master of Science Degree), each extending over a two-year period, will be required in various subject matter areas important in aquaculture and inland fisheries, including general aquaculture, fish diseases and parasites, fish feeds and nutrition, lake management, and fishery biology.

4. Pen culture investigations be initiated in Quisto-Cocha Lake to determine if this method of aquaculture has potential in Peru. A minimum of 12 pens, each with total surface area of 50 m², is recommended for testing three fish species during the first year of investigation.

5. The Ministry of Fisheries conduct a critical survey of all government fisheries stations in Peru to determine the major contribution of each to the national fisheries program. Those stations that cannot be operated efficiently due to conditions of polluted water or excessive maintenance costs should be closed, with biologists and other technical

personnel transferred to other stations where their efforts can be more effectively utilized.

This survey should include a complete inventory of all equipment present at each station with indication of condition, as well as a list of new equipment required to better carry out the principal functions of the station.

6. The Ministry of Fisheries carry out a study of its organizational structure with specific attention being given to overlap of work responsibilities in inland fisheries by various divisions or sections within the Ministry. Where excessive duplication of effort is found, reorganization or consolidation should be affected.

RECOMENDACIONES

En vista de la necesidad incrementada del desarrollo de las pesquerías de aguas interiores en Perú y del interés continuado en acuicultura evidenciado por el Ministerio de Pesquería y por el sector privado, se recomienda que:

1. El Ministerio de Pesquería debe proceder con planes de construir un centro de investigación de acuicultura de aguas calidas con un número suficiente de estanques experimentales de manera que se puedan desarrollar rápidamente métodos mejorados de cultivo de peces. Además de los estanques experimentales, se debe construir un número de estanques menores en tamaño para la producción de los alevinos, y otros estanques mayores para la producción de peces de consumo, las cuales servirán además para los propósitos de la extensión y demostración. Se necesitarán aproximadamente cien (100) estanques de tierra, cada uno con una superficie de agua de 0.1 hectare. Los estanques deben ser construido de tal manera que se puedan llenar y drenar individualmente.
2. Un programa especial de entrenamiento de 2 semanas de duración sea llevado a cabo en Perú a principios de 1973 por un equipo de tres profesores del Centro Internacional de Acuicultura, Universidad de Auburn.

Se sugiere que este programa, cooperativamente patrocinado por el Ministerio de Pesqueria y U. S. A. I. D. / Perú, ha de ser de gran beneficio a muchos biólogos y demás personal del Ministerio. La composición del equipo de entrenamiento se determinara a través de la selección de áreas temáticas que el Ministerio considere sea los más importantes para sus biólogos (Ingenieros pesqueros).

3. Un mínimo de dos becas por año por tres años consecutivos (6 en total) se hagan disponibles a personal seleccionado del Ministerio. Se requeriran becas para estudios avanzados de dos años de duración (Grado de Maestria) sobre varios áreas temáticas importantes en acuicultura y pesqueria de aguas interiores, incluyendo acuicultura general, enfermedades y parasitos de peces, alimento y nutrición de peces, manejo de lagos, y biología pesqueria.

4. Se inicie investigaciones de cultivo en corrales en el Lago Quisto-Cocha para determinar si este metodo de acuicultura posee potencial en Perú.

Un mínimo de 12 corrales, cada uno con una superficie total de 50 m², se recomienda para probar tres especies de peces durante el primer año de investigaciones.

5. El Ministerio de Pesquería conduzca un estudio crítico de todas las estaciones gubernamentales de pesquería en Perú para determinar la mayor contribución de cada uno al programa nacional de pesquería. Aquellas estaciones que no puedan ser operados con eficiencia debido a condiciones de aguas contaminadas o a costos excesivos de mantenimiento deben ser clausuradas, y los biólogos y demás personal técnico transferidos a otras estaciones donde se pueda utilizar con mayor efectividad sus esfuerzos. La información acumulada en este estudio debe incluir una lista completa de todo el equipo en cada estación con indicación de su condición, como también de equipo nuevo requerido para llevar a cabo mejor las principales funciones de la estación.

6. El Ministerio de Pesquería lleve a cabo un estudio de su estructura organizacional dando atención específica a los casos donde las responsabilidades de trabajo en las pesquería de aguas interiores de varias divisiones o secciones dentro del Ministerio se entrelazan. Donde exista excesiva duplicación de esfuerzos, se debe reorganizar o consolidar.

AQUACULTURAL DEVELOPMENTS IN PERU

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Introduction

For an indefinite period beginning April 1, 1972, the inhabitants of the greater Lima area will be unable to purchase red meat (beef) for the first 15 days of each month. In other cities and in rural areas of Peru, people will be unable to obtain beef two days of each week. The severity of the program of beef rationing recently instituted by the Government of Peru reflects the present inadequate supplies of beef within the country. It also reflects the determination of the Peruvian Government to significantly reduce its outlay of foreign exchange for importation of beef from neighboring countries of South America.

In an effort to compensate for reduced availability of beef, the Government of Peru is strongly advocating increased consumption of fish. In this regard, the Ministry of Fisheries is striving to develop to the fullest possible extent the State's marine and inland fishery resources, including aquacultures. The Minister of Fisheries addressing the nation over television and radio on January 13, 1971, informed the people of specific projects aimed primarily at increasing Peru's production of fish for human consumption. To achieve this goal, the Government plans to invest \$211

million over the next five years, and it is anticipated that the private sector will invest an even greater sum over the same period.

Status of Fisheries in Peru

Marine Fisheries

In terms of total fish catch, Peru is the greatest fishing nation in the world with the total catch in 1970 amounting to approximately 12.57 million metric tons. Over 95 per cent of this harvest, actually 12.38 million MT, consisted of anchovy that subsequently was processed into fish meal at the average conversion of 5.37 tons of anchoveta for each ton of fish meal produced. A fleet of 1,450 purse seiners, with an average load capacity of 130 tons, participated in the anchovy fishery, and 118 fish meal plants were in operation during 1970.

The catch of marine fish for human consumption was estimated at approximately 190,000 MT for 1971. Of this total, 140,000 MT were consumed by Peruvians with approximately 106 MT utilized in the metropolitan area of Lima. Present average consumption of fish per capita for this metropolitan area is estimated at 8 kg per annum; while cities located inland near rivers have annual per capita fish consumption exceeding 25 kg.

IMARPE (Instituto Del Mar Del Peru) indicates that 3,390 boats are engaged in the harvest of fish for human consumption of which 2,146 are small motorized boats and the remainder are without motors. The

Government provides technical and financial assistance to companies and fishermen involved in the food fish industry through EPSEP (Empresa Publica De Servicios Pesqueros). This semi-autonomous agency within the Ministry of Fisheries is responsible for the development of the food fish industry, including all aspects of marketing.

In terms of the labor employed, 21,995 fishermen were engaged principally in the industrial catch of anchovy for production of fish meal, 19,641 were involved in the catch of marine fish for human consumption, and 4,000 in shrimp fishing operations. In addition a total of nearly 11,000 persons was employed in fish processing operations with the majority associated with fish meal production.

Inland Fisheries

The principal freshwater or inland fisheries in Peru consists of trout in the Sierra region and a variety of warmwater fish species which occur in the Amazon River and its tributaries in the low jungle areas of eastern and northern Peru (Figure 1).

Lake Titicaca, a two-million-acre lake located in southeastern Peru at an altitude of 12,500 feet, afforded the most significant trout fishery in the country when, in the mid-1960's, nearly 250,000 kg of canned trout were exported annually to European and North American markets. Apparently uncontrolled exploitation of this fishery resulted in progressively reduced catches and in 1969 the lake was closed to commercial trout fishing



Figure 1. Map showing various Departments of Peru and the three major zones (North, South, and East) in which the Direccion De Pesca Continental (Direccion General De Extraccion) administers inland fisheries programs.

(Boundary Representation Not Necessarily Authoritative)

and all trout canneries ceased operations. Additional information concerning the trout fishery of Lake Titicaca with recommendations for re-establishing the trout population can be found in a report issued by the International Center for Aquaculture entitled, "Fishculture Survey Report for Peru" (Smitherman and Moss, 1970).

Major fishing activity in the jungle regions of Peru is concentrated on the Amazon River in the general vicinity of Iquitos and on the Ucayali River, a tributary of the Amazon, near the city of Pucallpa. Both of these are quite significant fisheries during the dry season, normally the period from mid-June to mid-November. Since fishing in rivers during the rainy season is practically impossible due to the excessively swift currents, most of the fishing activities during the flood period must be carried out in oxbow lakes.

The city of Iquitos, with its 100,000 inhabitants, is located in Northeast Peru on the Amazon River. Harvest of fish in the general area of Iquitos has been reported to average 825 tons per year with an actual demand of 1,500 tons per year and a harvest potential exceeding 3,300 tons annually (Ellingsen and Johnston, 1971). Reliable information on the fish catch in the general area of Pucallpa is not available.

Potential for Aquaculture

Coldwater Fishculture

Aquaculture, the raising of fish and other aquatic animals in cages, pens, raceways, ponds, or other waters, had its start in Peru some three decades ago when the first Government trout station became operative. In time, trout farming operations developed on a commercial basis and at present such operations are on the increase. The status of trout culture in Peru has been outlined in a report issued by the International Center for Aquaculture (Shell, 1971). In the present report, therefore, further considerations of aquaculture will be largely limited to tropical or warmwater cultures.

Warmwater Fishculture

Interest in warmwater aquaculture in Peru is high with many farmers and landowners eager to construct ponds in which crops of fish can be produced. However, the Government realizes that an effective aquacultural program can develop only after certain basic information is obtained on the most suitable fish species for culture as determined by such parameters as rate of growth, conversion of feed into fish flesh, total net production, optimum stocking rates and economic return to the farmer. It is in this connection, then, that the Ministry of Fisheries is seriously contemplating the construction of a modern aquacultural facility in which improved methods of aquaculture most applicable to conditions in Peru can be developed.

Although interest in tropical fishculture by the private sector is very high at the present time, a significant pond fishculture program can be expected to develop very slowly unless the Ministry of Fisheries establishes a broad-based aquacultural testing program in which tried and proven aquacultural techniques can be extended to persons interested in fishculture operations.

Peru possesses a combination of attributes that provides unusually good potential for aquacultural development, not the least of which are:

1. The population of the jungle areas are concentrated along rivers as those waters afford the principal mode of transportation and use of fish as food is traditional in their diet.
2. During the six-months rainy season, the strong demand results in a high market price for fish because commercial fishing operations in rivers are curtailed due to excessively swift waters.

For example, in a restaurant in Iquitos frequented by the writer during March, 1972, fish dishes consistently carried the highest prices of any food item on the menu, including chicken, pork, and beef.

3. It has been reported that 1,800 different fish species inhabit the Amazon River and its tributaries, with over 500 species of catfishes alone. From this wide variety, many

fishes should possess the characteristics desirable for intensive fishculture operations. Several fish species that should certainly be tested in production performance trials are shown in Figures 2. through 5.

4. The growing season in tropical jungle areas extends throughout the calendar year whereas it averages only seven months in Southern United States--a region where a very significant aquacultural industry with channel catfish has developed in recent years. Greater fish production can be achieved with a longer growing season.

5. Fish meal, the basic ingredient of fish feeds, is available in abundance in Peru, at a relatively low cost. In 1970, the price ranged from approximately \$143 per MT for fish meal in powder form without antioxidant to \$150 per MT for fish meal pellets with antioxidant.

6. Labor costs are comparatively low, thus contributing toward lower production costs for the cultured fishery product.

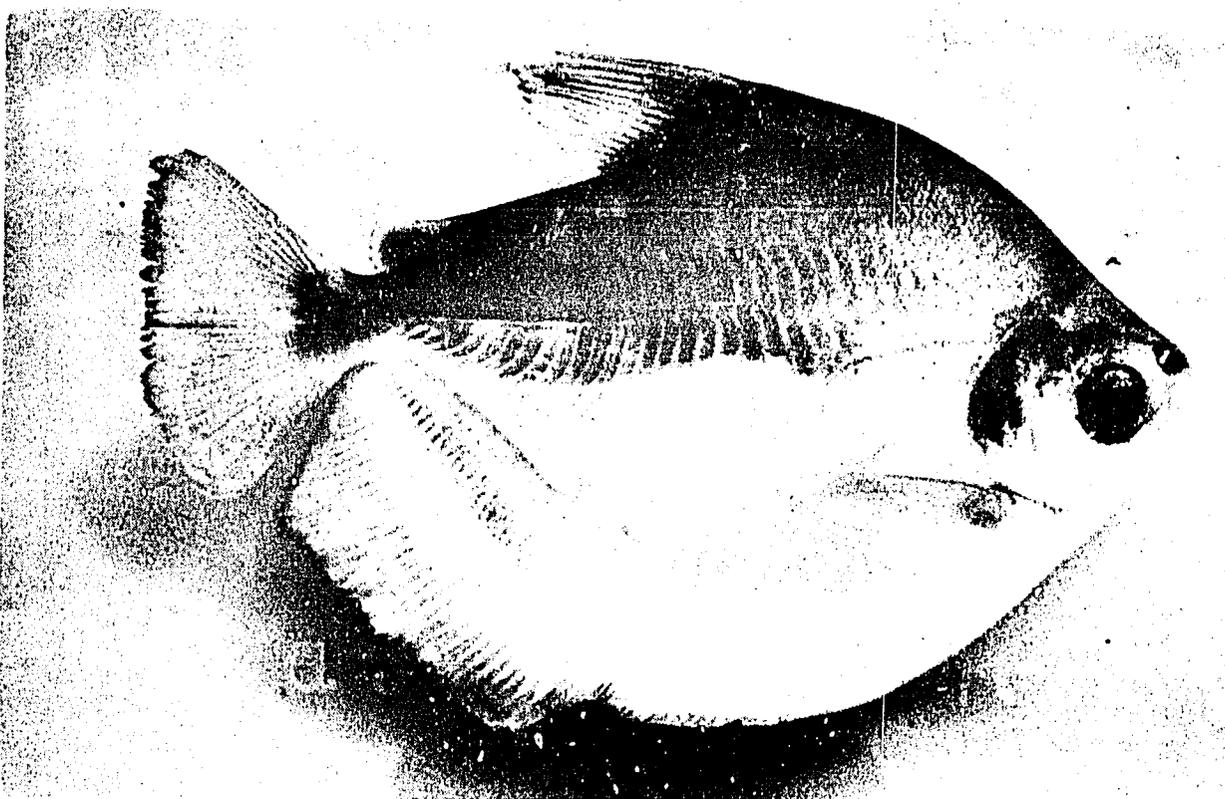
Fishculture in the Pto. Maldonado Area

The particular set of circumstances prevailing at Puerto Maldonado provides some reason for optimism regarding the possibility of establishing a small, viable aquacultural development in this region of



Figure 2. Freshwater corvina, Plagioscion squamosissimus, a highly prized food fish in Peru, has been successfully spawned in aquacultural facilities in a neighboring country, but little is known of its culture potential in ponds.

Figure 3. A fish known to have a very rapid rate of growth when placed in ponds is the palometa, Metynnis sp. Experiments with this species should be carried out to determine maximum production, optimum rate of stocking, and costs per kg of fish produced.





Paco, Colossoma bidens, weight 5 kg (11 lbs)



Gamitana, Myletes bidens, weight 11 kg (24 lbs)

Figures 4. and 5. These two fish species taken from Lake Valencia show good potential for pondcultural operations in Peru as they feed on a wide variety of materials, grow at a rapid rate, and tolerate handling with minimal injury.

Peru for local consumption. Additional protein is desperately needed by the inhabitants of Pto. Maldonado, especially during the six-months rainy season when commercial fishing activity in adjacent rivers practically ceases due to high water and swift current. The extent to which a shortage of high quality protein exists can be best visualized by the following: the total supply of beef for the city's 8,000 inhabitants normally consists of two slaughtered cattle per week. It was reported that persons must line up in front of the local butcher shop long before daylight in order to have an opportunity to purchase beef before the limited supply is exhausted. Regular cuts of beef sell for 18 soles/kg (\$0.18/lb) while lomo or filets bring 34 soles/kg (\$0.35/lb). Price of fish normally runs 20 soles/kg (\$0.20/lb) on a live weight basis.

The Pto. Maldonado area possesses many characteristics essential for aquacultural development: 1) the people are quite fond of fish as food; 2) the demand for fish is great with an exceptionally good market price prevailing during the rainy season; 3) reasonably good sites for construction of fish ponds; and, 4) an abundance of fish species in local rivers-- some of which appear to have excellent potential for intensive culture in ponds (Figures 6 through 8).

The principal disadvantage, and the elements which will limit the development of fishculture in this region of Peru beyond local needs, are the limited development of agriculture and inaccessibility. A moderate amount of livestock farming, chiefly grazing of cattle, can be observed around Pto. Maldonado, but very little grain is produced in this jungle area.



Figures 6. and 7. This catfish known locally as maparate, Hypophthalmus edentatus, occurs in the Amazon River at Iquitos. Features that make this fish a particularly interesting species for testing in fish ponds are: small size of head relative to total body size (resulting in comparatively high dress-out weight); absence of spines in fins (contributing to ease of handling); it is a filter feeder (should be an extremely efficient species for pond culture).



Note the very long and closely spaced gill rakers that function to strain food materials (plankton) from the water. As far as is known, this species has never been tested in fish ponds.



Figure 8. One of the larger catfish species found in the major rivers of Peru. Zungaro, Pseudopimelodus sp., is highly regarded as a food fish. The fish above was taken by hook and line from Lake Valencia and weighed 23 kg (50 lbs). Zungaro should be tested to determine its pond culture potential.

Figure 9. View of Piscis Granja La Cachuela. This station, located 5 km from Pto. Maldonado, was constructed at a cost of 400,000 soles (\$9,300) by the Junta De Obras Publicas. Although this facility is small, 4 earthen ponds each with a surface area of 760 m², 10 concrete tanks, and a storage building, good information on fishculture could be developed if a carefully planned testing program is followed. The Ministry of Fisheries is providing technical services to the Junta for this fishcultural project.



This situation would necessitate transport of fish feeds, fish meal, and rice bran probably from Lima. Pto. Maldonado has air service, but air transportation is a rather expensive method to bring in materials for feeding animals. The city is serviced by a road to Cuzco, but even in the dry season, travel is difficult due to the unimproved condition of the road.

Although potential for intensive aquaculture in the Pto. Maldonado area does not appear great at the present time, the Direccion De Pesca Continental should take full advantage of the opportunity it has to secure accurate economic data on aquaculture operations being carried out at Pisci Granja La Cachuela. This small fishcultural facility was constructed in 1971 by the Junta De Obras Publicas Del Departamento De Madre De Dios. There are four earthen ponds, each with a surface area of 760 m², 10 small concrete tanks, and a small house (Figure 9).

The Cachuela Fish Farm is quite small in terms of numbers of ponds. However, valuable aquacultural information can be obtained providing a good testing program is followed. At the time of visit, each of the earthen ponds contained different fish species: 1) paiche; 2) tucunare; 3) boquichico plus sabalo; and, 4) corvina plus tilapia. A stocking program of this nature will not provide reliable data nor accurately test the potential of the fish species for fishcultural purposes. The Ministry of Fisheries should assist the Junta De Obras Publicas by planning a meaningful testing program designed to provide accurate information on fishculture in the Pto. Maldonado area.

It is also recommended that the Ministry of Fisheries assist the Junta De Obras Publicas in properly exploiting the fishery resources of Lake Valencia. This 450-hectare oxbow lake, located near the Bolivian border, is connected to the Rio Madre De Dios by canal. Apparently, large numbers of fish, chiefly zungaro, gamitana, and paco, congregate in the lake during the flood season to seek temporary respite from the swift current of the river. During the summer or dry season, fish species most abundant are corvina, boquichico, and palometa. At present, there is only a single fisherman family residing near the lake who is fishing the lake with any degree of regularity. The fish, caught principally by hook and line, are smoked and sun-dried and transported to Pto. Maldonado by motorized canoe. The Ministry of Fisheries is considering installing an ice plant at Pto. Maldonado and providing the Junta De Obras Publicas with a boat equipped with ice chests and large outboard motor in order that fresh fish may be transported from Lake Valencia to Pto. Maldonado--a trip requiring approximately three hours one way--on a regular basis. This is a good plan and should be implemented at the earliest possible date as this will encourage a greater number of fishermen to fish the lake. Consequently, a greater supply of fish will be available for the people of Pto. Maldonado.

Fishculture in the Iquitos Area

Fishcultural operations in the region of Iquitos presently are being carried out on a very limited basis by the private sector.

Fishculture farming operations observed in this region could be most accurately described as extensive rather than intensive. The few operators involved in aquaculture appear to be making a fair return on their investment (Smitherman and Moss, 1970). It is doubtful, however, that aquaculture will become firmly established in the Iquitos region until improved cultural practices can be developed that will result in increased fish production and provide greater economic return to the individual farmer as well.

The potential for fishculture in Iquitos appears good for the same general reasons as were cited for Pto. Maldonado. In addition, agricultural by-products that would serve as food for fish are available, as are certain prepared animal feeds. During this visit to Iquitos, numerous sites were observed where fish ponds could be constructed. However, an extensive pond construction program for the area certainly should not be proposed prior to development of tested and proven methods of producing acceptable crops of pond-cultured fish.

Proposed Project for Culturing Fish in Pens

The Ministry of Fisheries has been involved with pen culture projects at Lake Sauce for about five years, and at Lake Sandoval for a shorter period. In both projects, however, emphasis has been on growing fish species, principally paiche, to sub-adult size for release in natural waters. To what degree this stocking method has contributed toward

establishing spawning populations of paiche in waters where it has been introduced, or in increasing the paiche fishery in other areas has not been determined. A long-term study in which a large number of paiche are tagged prior to their release, with tags being recovered from fish harvested during subsequent years, would provide data on which the effectiveness of this stocking technique could be properly evaluated. Such a tagging study should be initiated if the Ministry intends to continue the present stocking program with paiche.

At the present time, the economic potential of culturing food fish in pens is not known. However, from experiments conducted at the International Center for Aquaculture in 1971, this method has very interesting possibilities. Maximum net production of two fish species, channel catfish and tilapia, stocked in combination and given supplementary feeds amounted to approximately 20,372 kg/ha (18,000 lbs/A) in a seven-months period.

The major requirements for pen culture include the following:

- 1) materials at relatively low cost for feeding fish;
- 2) low cost materials for constructing pens; and,
- 3) adequate numbers of fingerling fish available at appropriate time.

It is also important that the pen culture facility be located relatively near fish markets so as to minimize costs of transporting fish and necessary supplies. Location also is important inasmuch as a caretaker or worker is required to reside near the pen culture facility to feed the fish each day and prevent harvest of the fish crop by unauthorized persons.

To determine the potential of pen culture for tropical regions of Peru, it is recommended that a pen culture project be initiated at Quisto-Cocha Lake near Iquitos. This particular location offers several advantages: 1) close proximity to the Loreto Fisheries Station would permit personnel of this station to service the pen culture project; 2) earthen and concrete ponds of the Loreto Fisheries Station could be utilized to very good advantage for growing fish species to be tested in pen culture experiments from the fry stage to advanced fingerling stage; 3) limited access to the lake by the public would greatly reduce potential poaching problems; and, 4) water level fluctuations of the lake are minimal.

The same general design should be followed in Quisto-Cocha Lake as was utilized for pens constructed in Sandoval and Sauce Lakes. It is suggested, however, that it would be more economical to construct this facility as a single series of connected pens rather than in clusters of four as was built in Sandoval Lake. Thus, each pen, excepting the two on either end of the series, would have two walls in common with adjacent pens. A total of 12 pens should be built, each 10 x 5 m, with the shorter side serving as the common wall of two adjacent pens. At the International Center for Aquaculture, pens of 100 m² are being utilized in pen culture experiments, but smaller pens (50 m²) will cost less and should still provide adequate fish production data.

The wooden stakes used in the construction of the pens should be of a type that are resistant to decay, thus ensuring that pens will last for

several experiments without requiring major repair.

The experimental design suggested for 12 pens is as follows:

<u>Number of pens</u>	<u>Fish species</u>	<u>Stocking rate/pen (50 m²)</u>
2	paiche	50
2	paiche	25
2	gamitana	100
2	gamitana	200
2	paco or sabalo	100
2	paco or sabalo	200

Carnivorous fish species generally are not profitable to culture except possibly in combination with a forage fish species. However, paiche is suggested because of its importance as a food fish and its high market price. Gamitana and paco are recommended because of their acceptance by the people and because they reportedly have a wide variety of food habits. Also, these species grow rapidly and can be handled easily.

Stocking of pens should be completed within one week or less and accurate weights should be obtained as the fish are stocked in each pen.

The fish should be fed daily at rates of 6 per cent total body weight for the first month; 5 per cent for the second month; 4 per cent for the third month; and, 3 per cent for each additional month. Fish samples should be taken monthly by seine and the samples weighed accurately to obtain reliable estimates of total weight of fish so that subsequent adjustments of feeding rates can be made.

Of course, to properly evaluate pen culture as a potential fish farming method, accurate records of all expenses should be maintained including those for pen construction, fish for stocking, feed materials, labor, etc.

Proposed Warmwater Aquacultural Research Station

The construction of a fishcultural testing facility and the development of a viable research program necessarily will require a substantial investment in terms of funds for construction and maintenance of the station, and personnel and technical services for conducting the research program. It is most important, therefore, that adequate care is taken not only in locating the research station, but in designing and constructing the facility as well.

The major initial decision that must be made concerns the general area of the country that will be most suitable for locating a warmwater fishcultural station. Obviously, a tropical fishcultural station must be located east of the Andes Mountains in the selva or jungle region. Pucallpa appears most suitable because of the following reasons:

1. Pucallpa lies in the central portion of Eastern Peru and this would be a convenient site for conducting extension and demonstration programs in fishculture for farmers and pond owners and for carrying out short-course training programs for biologists and other personnel of the Ministry of Fisheries.

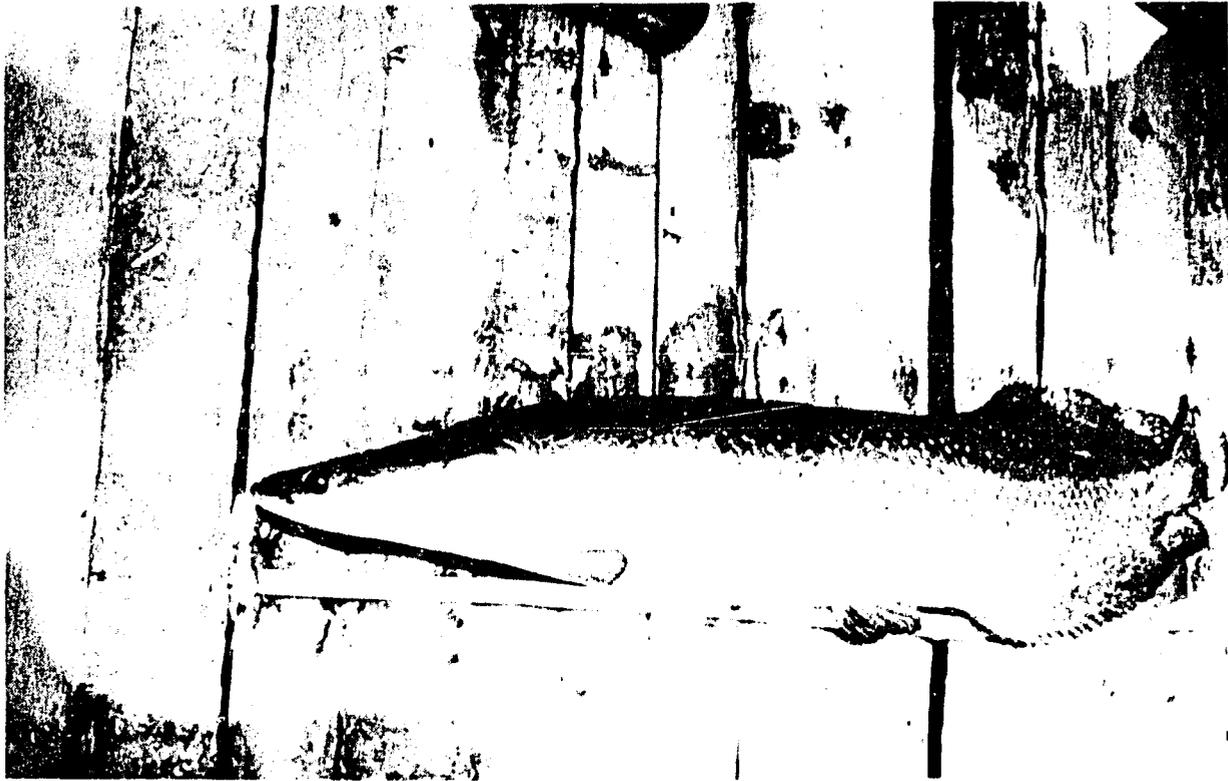
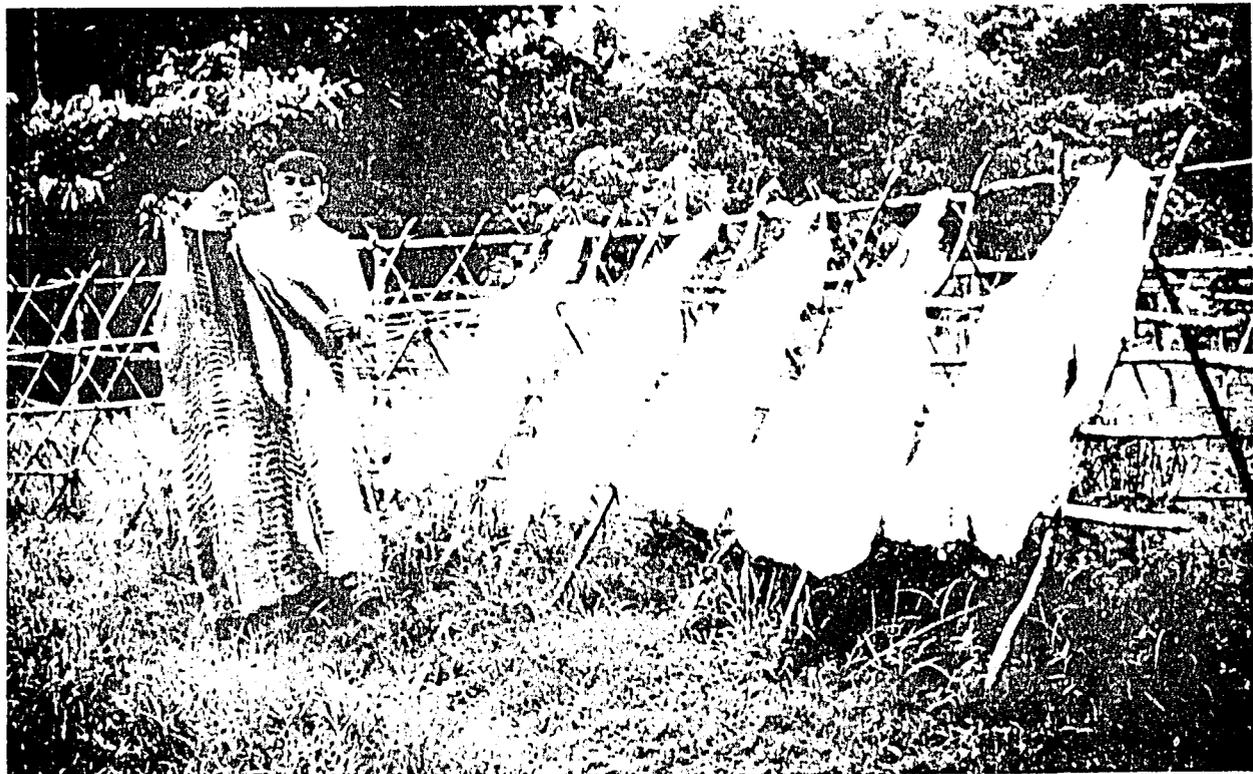


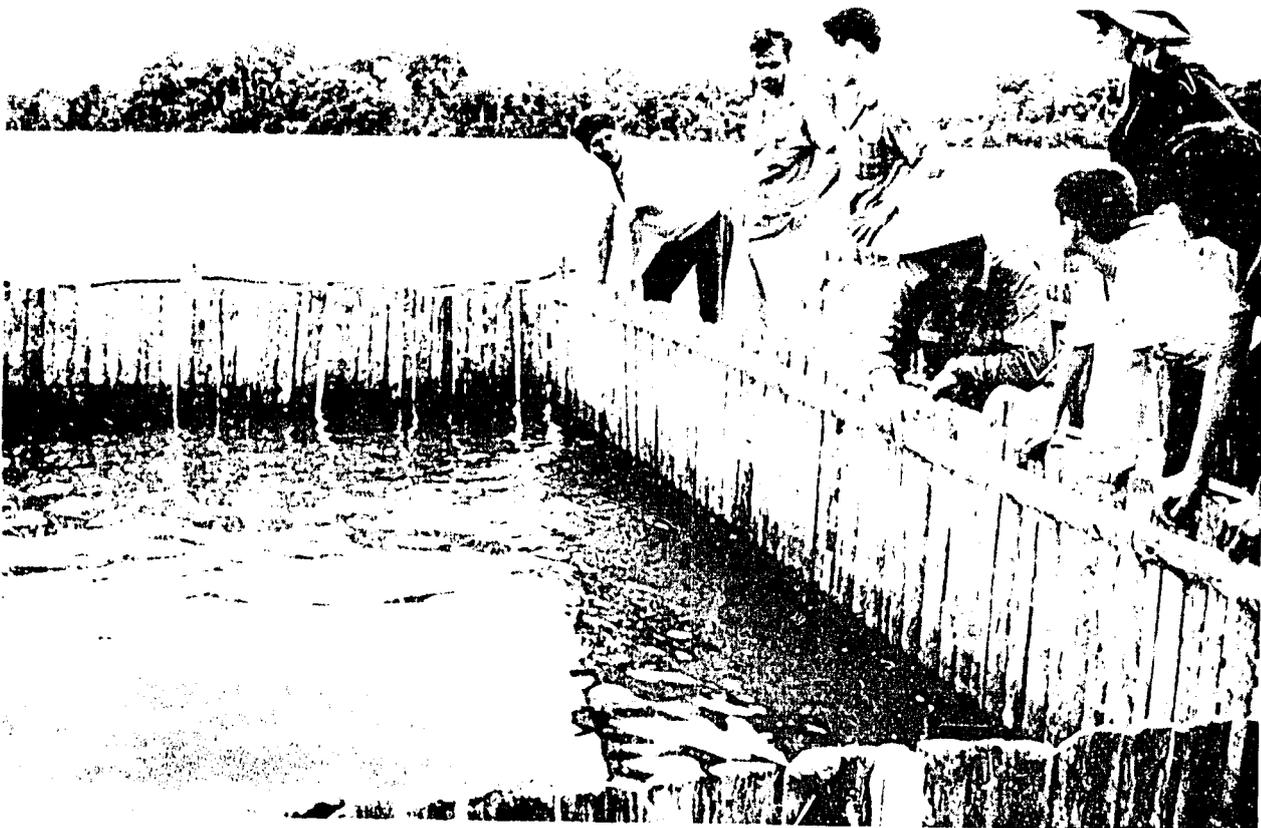
Figure 10. This 5-kg paiche, Arapaima gigas, grew from approximately 40 to 75 cm in size in pens located in Sandoval Lake in a one-year period. It is being measured prior to release in the lake where it is hoped that the species will become established and contribute to the fishery.

Figure 11. These huge paiche filets are being processed, salted and sun-dried, for later sale in Iquitos at 50 soles/kg (\$0.52/lb) or in Lima for 100 soles/kg (\$1.05/lb). To date there has been no experimentation to determine if it is economically feasible to culture this species in pens or ponds.





Figures 12. and 13. Pens constructed in Lake Sandoval have been utilized principally for growing paiche to sufficiently large sizes to enable them to escape predators such as the piranha. The paiche are then released into the lake where it is hoped that they will become established and eventually provide a fishery. Pen culture experiments carried out at the International Center for Aquaculture, Auburn University, gave maximum net production of 20,000 kg/ha with two species, channel catfish and tilapia, receiving supplementary feeding over a 7-months period.



2. This city can be conveniently reached from Lima where central offices of the Ministry of Fisheries are located. This is especially important as frequent visitation to the research station by supervisory officials of the Ministry will be essential throughout the construction period, and particularly during the early years of the testing and research program.

3. In addition to air transportation facilities, the city is serviced by an all-weather highway. The significance of this is that fish meal and other supplies and construction materials can be trucked one way from Lima to Pucallpa in about 16 hours.

Likewise, fish produced from commercial fish farming operations could be marketed in Tingo Maria or Cerro De Pasco (approximately 120 km and 240 km, respectively, from Pucallpa) as well as in Pucallpa.

4. The city is in close proximity to the Ucayali River, a major tributary of the Amazon. Hence, fish of various species could be readily obtained for testing purposes.

5. Pucallpa is a city of approximately 70,000 inhabitants, with good medical and educational facilities and adequate housing and shopping areas. Thus, biologists and their families would not object to living there.

In addition to the criteria outlined above, several other requirements are essential for an aquacultural facility. Foremost among these

are an adequate water supply free of pollution and a good clay soil. Water may be supplied to the station from a stream or water supply reservoir. In either case, filling ponds by gravity flow is much preferred because pumping water is expensive and often unreliable due to breakdown of the pumping equipment and temporary loss of electrical power. A good quality clay soil is absolutely necessary if excessive seepage, resulting in water loss through the dams or pond bottoms, is to be avoided.

The aquacultural station should contain about 100 experimental ponds, each with a surface area of 0.1 ha. Since the station likely will serve in part as a hatchery for production of fingerlings for distribution to farmers and also as a center for extension and demonstration of modern fishcultural techniques, a number of ponds of larger size will be required. The pond complex should be designed so that each pond can be filled and drained individually of other ponds in the system.

In addition to the land area actually required for the experimental pond complex and water supply reservoir, other land will be needed for buildings--a laboratory, fish-holding house, combination garage and workshop, and residences for certain station personnel including watchmen, the station superintendent, and at least one biologist. In total no less than 50 hectares of land should be acquired by the Ministry for development into a warmwater aquacultural research center.

Several meetings were held with various biologists and other personnel of the Ministry in which the major features in designing and

constructing a tropical aquacultural research station were discussed in detail. It was suggested that these biologists locate several potential sites in the general vicinity of Pucallpa. Then staff from the International Center of Aquaculture, upon request by U.S.A.I.D./Peru, will personally visit each site in the field and select the one most suitable for development. Our staff will assist in designing the aquacultural research facility and in drawing up cost estimates if this is desired by the Ministry of Fisheries.

THE MINISTRY OF FISHERIES

Organizational Structure

Prior to 1970 fisheries work in Peru was carried out by the Servicio De Pesqueria (Fisheries Service) under the Ministry of Agriculture. However, the increasing importance of fisheries in recent years, with fish meal exports accounting for approximately 25 per cent of Peru's total foreign exchange income, contributed in the Fisheries Service's elevation to full ministerial status in 1970.

The General Law of Fisheries - Decree Law 18810 - was promulgated and approved in 1971. This decree reaffirms the Government's control over all of Peru's marine resources and clearly establishes the authority of the Ministry to direct all aspects of fisheries development. Principal responsibilities of the Ministry include: 1) maintaining a register of boats, factories, and contracts; 2) granting authorizations, permits, licenses, and concessions; 3) approving reinvestment programs; and,

4) developing and supervising programs of research and training.

A chart showing the entire organizational structure of the Ministry is presented in Figure 14. Upon examination of this chart, it is obvious that the Ministry is highly oriented toward marine fisheries. However, at least four major agencies within the Ministry of Fisheries sponsor programs in inland or freshwater fisheries. These are: IMARPE (Instituto Del Mar Del Peru); EPSEP (Empresa Publica De Servicios Pesqueros); Direccion General De Extraccion; and Direccion General De Investigacion Cientifica Y Tecnologica. The same divisions also are involved in various work programs relating to marine fisheries.

There may be some real advantages in dividing responsibilities in freshwater fisheries programs among various agencies of the Ministry. However, it does appear to the writer that excessive duplication of effort in inland fisheries programs presently exists within the Ministry.

A few examples may be useful to point out these areas of apparent duplication. The Direccion General De Extraccion, specifically the Direccion De Pesca Continental, operates several warmwater fisheries stations where, over the years, programs on the culture of paiche have been carried out.

The Direccion General De Investigacion Cientifica Y Tecnologica, which is staffed with qualified biologists but possesses no field or experimental stations, has two biologists investigating the biology and life history of paiche in Sauce Lake and two additional biologists carrying out limnological studies on Medio Mundo.

The Instituto Del Mar Del Peru (IMARPE), a semi-autonomous agency under the Ministry but which is dependent, in part, upon the Ministry for funds, presently has stationed at Iquitos, three biologists who are engaged in biological studies of various fish species.

EPSEP (Empresa Publica De Servicios Pesqueros), another semi-autonomous entity under the Ministry of Fisheries, is responsible for the development and improvement of the food fish industry in marine and inland waters and has personnel stationed at Iquitos as does the Direccion De Pesca Continental.

IMARPE has a staff of two biologists working at Puno and Lake Titicaca on a trout project whereas the Direccion De Pesca Continental employs a number of biologists to operate the trout stations for which it is responsible.

The situation of duplication of work activities among various agencies should be carefully considered by appropriate administrators of the Ministry. If excessive duplication does in fact exist as indicated in Figure 15, steps should be taken to correct it. This situation invariably results in inefficient and costly administration, duplication of equipment, and usually, inadequate exchange of project information and results among the personnel of the various agencies carrying out the fisheries programs.

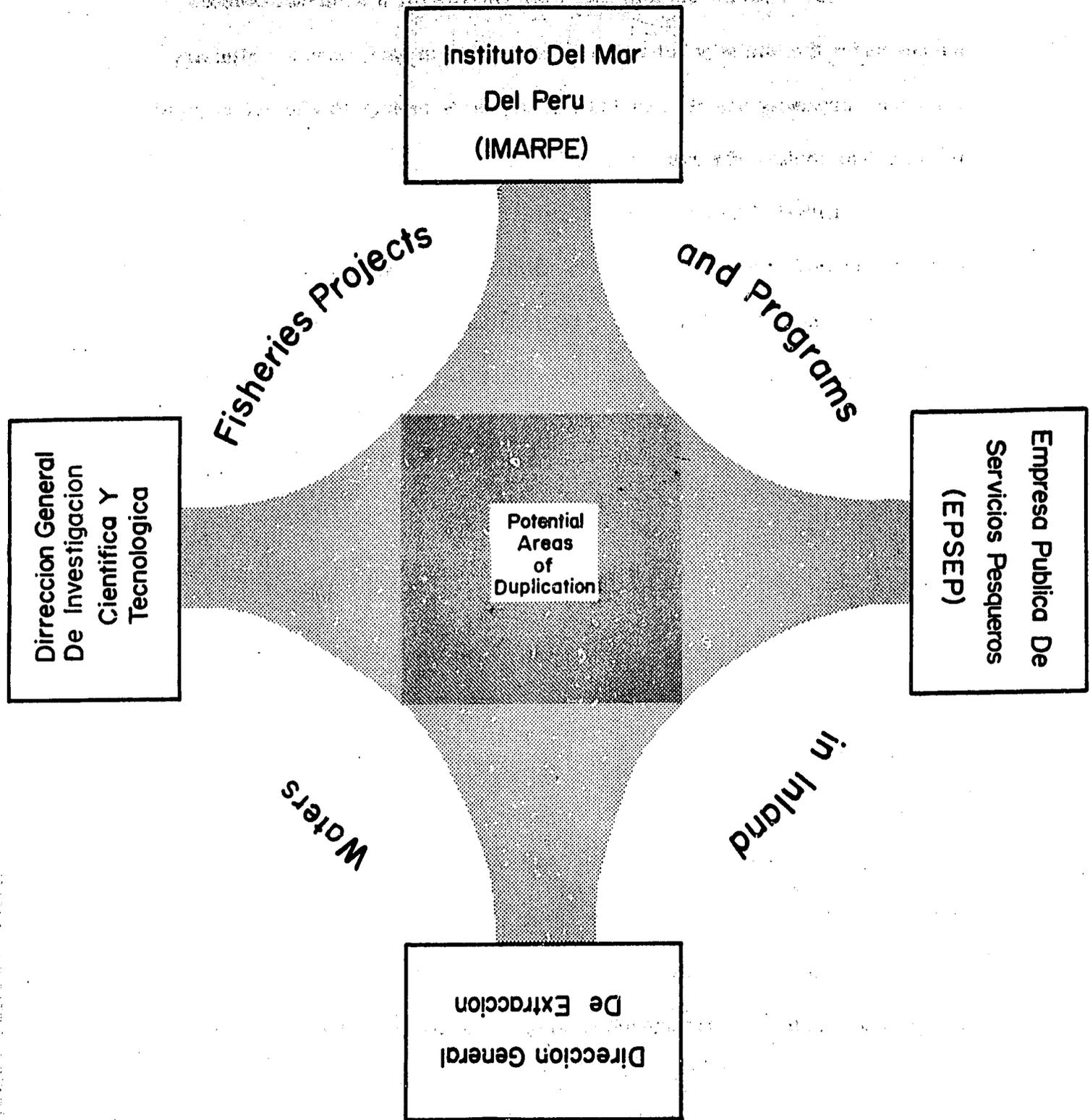


Figure 15. Chart showing major agencies within the Ministry of Fisheries that presently administer programs in inland fisheries. The darker shaded area illustrates potential overlap of responsibilities and duplication of effort among the four groups--a situation that may result in increased costs for administration and probably reduced effectiveness of work programs as well.

Fisheries Stations and Equipment:

Eleven fisheries stations presently are operated by the Ministry of Fisheries under the administration of the Direccion General De Extraccion. Information on the location and principal function of each is summarized in the table on the following page.

Six stations are located in the Sierra region and function chiefly as trout hatcheries. Several of the trout stations were visited in 1971 by staff of the International Center for Aquaculture who evaluated work projects and made recommendations to improve the effectiveness of various stations (Shell, 1971).

In addition to trout facilities, the Ministry has a marine station at Tumbes where a project in oyster culture is being carried out. Two stations have work programs concerned with freshwater shrimp and the two remaining stations are involved in warmwater fishcultural projects.

The Tarapoto Station is located at Sauce Lake where a pen culture project with paiche has been underway for approximately five years. This project, however, is being terminated by the Direccion General De Extraccion in 1972 although the life history and biology of the paiche will be under investigation by biologists of another agency of the Ministry. Work with paiche at the Tarapoto facility mainly consisted of collecting young paiche from the rivers in the region, growing them to sub-adult size in

Table 1. Location and principal function of eleven fisheries stations operated by the Ministry of Fisheries

Department	Station	Principal function	Established
Tumbes	Tumbes (Pto. Pizarro)	Oyster culture	1958
Lima	Chancay (Medio Mundo)	Freshwater shrimp and liza culture	1966
Arequipa	Camana	Freshwater shrimp hatchery	1955
Ancash	Huaraz	Trout hatchery	1958
Cuzco	Sicuni (Lancui-Layo)	Trout hatchery and suche culture	1963
Huanuco	Huanuco	Trout hatchery	1958
Junin	Junin	Trout hatchery	1940
Lima	Santa Eulalia	Trout hatchery	1944
Cajamarca	Cajamarca	Trout hatchery	1954
Loreto	Iquitos (Quistococha)	Tropical fishculture	1940
San Martin	Tarapoto (Sauce)	Tropical fishculture	1967

The Loreto Fisheries Station is currently the only aquacultural facility operated by the Ministry of Fisheries with earthen ponds in which tests on production methods and economic return may be carried out utilizing tropical fish species. However, a major limitation of this station is its relatively small size; 20 small concrete and earthen ponds with a total water surface of 0.14 ha. Normal aquacultural testing procedures require the use of eight ponds (four control and four replications of the treatment) for a single experiment. Hence, a rather large number of experimental ponds, approximately 100 in number, each with a surface area of 0.1 ha, is required if improved methods of aquaculture are to be developed rapidly.

Unfortunately, the Loreto Station has little potential for expansion as soil in the remaining land available to the station is quite sandy and the water supply is inadequate to support more than a few additional ponds. Water to supply a new pond complex could be pumped from Quisto-Cocha Lake. This, however, would require installation of power lines for electric motors or diesel engines to operate the pumps. Since such systems are expensive to install and maintain, they cannot be recommended except when there are no other alternatives.

Other features of the Loreto Fisheries Station that reduce its usefulness are its location and inaccessibility. Iquitos is located in the extreme Northeastern portion of the country, a distance of over 1,000 km by air from Lima. The city is accessible only by air, approximately two hours by jet aircraft from Lima, and by river. Travel to Iquitos is both

expensive and somewhat unreliable, particularly during the six-months rainy season.

The research program of this station has been reviewed by Smitherman and Moss (1970) and various recommendations were made for improving the program. It was obvious that some of the recommendations were followed. However, during the recent visit, workers were observed feeding fish in ponds in much the same fashion as was practiced in the past, that is, applying a few handfuls of feed rather than giving a pre-determined quantity of feed based upon percentage of total weight of fish present.

Also, data on total weights of fish produced in given ponds were available, but responses to questions concerning rates of conversion (amount of feed required to produce one kg of fish), adjusting feeding schedules, and production costs were vague. This, in part, is possibly due to lack of appreciation for and knowledge of modern fishcultural techniques. This condition could be changed by providing a program of in-country and graduate training abroad as proposed in this report.

Another situation which contributes to the underdeveloped quality of Loreto's aquacultural program is that of inadequate equipment. A specific example can be cited. In order to conduct chemical analyses of pond waters at the station, it was necessary for biologists to transport a Hach chemical kit to Iquitos from the central office in Lima. It would certainly appear that each station, trout or warmwater, with any meaningful program in aquaculture should have a basic water analysis kit available

on a permanent basis. It is especially necessary to monitor dissolved oxygen, pH and CO₂ several times weekly, and occasionally more often.

Another example can be cited. During the writer's initial visit to this station in 1970, ground transportation was by Jeep pickup truck which had either to be parked on a hill or pushed in order to start the engine because of a faulty bendex. On the recent trip to Iquitos, the same truck with the same malfunctioning starter mechanism was used.

These examples certainly are not given to embarrass any of the supervisory personnel of the station or to criticize the Ministry of Fisheries. Rather, it is to emphasize that fisheries work is of sufficient challenge even when technicians and biologists have necessary equipment with which to work. But when station personnel must carry out their work with inadequate supplies or equipment that works improperly, rapid progress in aquaculture and other fisheries programs cannot be expected.

It is therefore recommended that the Ministry of Fisheries make a critical review of all the government fisheries stations so that the contribution of each of these stations to the overall national fisheries program can be determined and evaluated. If it is determined that certain stations cannot be operated efficiently because of water pollution or excessive maintenance costs, the stations should be closed and biologists and other technical staff transferred to other stations where their efforts can be utilized more effectively.

In addition to surveying the overall work program of each station, a complete inventory of equipment, with indication of the condition of equipment, should be made and a list prepared of new equipment required. Every attempt should then be made by the Ministry to procure the equipment on a priority basis as may be established by the Direccion General De Extraccion and the Direccion De Pesca Continental.

Personnel and Training

The Ministry of Fisheries is a relatively large organization with over 300 technically trained staff. Within the group with which the writer worked, the Direccion De Pesca Continental (Direccion General De Extraccion), heads of divisions were college graduates with degrees mainly in the biological or agricultural sciences. Several of the technical staff attached to the central office in Lima or located at fishery stations throughout the country received their formal training at universities offering at least a few courses either in freshwater or marine fisheries, or both. In making a particular effort to evaluate the training received by biologists, the writer determined that university training in fisheries presently available in Peru is principally theoretical. Most of the biologists with whom the writer talked indicated that they had little or no opportunity to gain significant field experience during their college training. This is due to the fact that the various universities possess very limited experimental field facilities and/or field equipment and limited staff trained in fisheries. In addition, the universities

find it difficult, if not impossible, to transport students to the field. The end result is that the biology graduate has limited experience in actually carrying out applied fisheries techniques--for example, how to: 1) conduct a fish population study; 2) mark or tag fish; 3) measure and weigh fish; 4) calculate rates of growth and conversion; 5) determine rates of stocking and feeding; and, 6) spawn fish under hatchery conditions.

In an attempt to provide practical and applied type training for selected personnel of the Ministry, U.S.A.I.D./Peru has supported study tours to the United States for at least three Ministry employees. This is a good program and in view of the increased emphasis on food fish production, this program should be expanded.

In addition, it is suggested that a special two-week training program be carried out in Peru by a team of three professors from the International Center for Aquaculture. This program, which the writer proposes to be sponsored jointly by the Ministry of Fisheries and U.S.A.I.D./Peru, will be of considerable benefit to biologists and other personnel of the Ministry since emphasis will be on application and demonstration of modern aquacultural and fishery techniques. Composition of the training team will be determined through selection of subject matter areas deemed by the Ministry to be most important for its biologists. It is proposed that the first in-country training program be scheduled for January, 1973.

It is also recommended that scholarships for advanced studies in fisheries be made available to selected personnel of the Ministry. Two

such scholarships per year for three consecutive years (6 in total) should be established with each to extend over a two-year period to allow sufficient time for completion of a Master of Science degree. The establishment of these long-term scholarships will be of particular importance in the event that an affirmative decision is made by the Ministry to develop a tropical aquacultural research center. Selection of qualified candidates for scholarship positions should be made at an early date in order that the participants may complete their study programs as soon as possible and return to Peru to assist in the development of the aquacultural center and the implementation of a meaningful research program. It is suggested that U.S.A.I.D./Peru, the UN/FAO Fisheries Project, and the Ministry of Fisheries jointly sponsor scholarship positions.

CONFERENCES

PERU MINISTERIO DE PESQUERIA

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REFERENCES

- Ellingsen, A.M. and L.D. Johnston. 1970. Development of the Amazonas Fishery. Memorandum to W. P. Appleyard, Director of UNDP/FAO Fisheries Project. Empresa Publica de Servicios Pesqueros. Lima, Peru. 17 typewritten pages.
- Gonzalez Lopez, J.L. and J. Corzo Moron. 1971. Informe del viaje a Iquitos del 23 de Noviembre al 14 de Diciembre de 1971, para organizar la Oficina de EPSEP encargada de la explotacion de los recursos naturales de las Zonas Reservadas de los rios Pacaya y Samiria. FAO Fisheries Travel Report and Aid Memoire No. FIEF/PER 35.
- Ministerio De Pesqueria. 1971. Reglamento De Organizacion Y Funciones. Setiembre, 1971. Lima, Peru. 137 p.
- National Marine Fisheries Service. 1971. Peru's Fishing Industry - 1970/1971. U.S. Department of Commerce. Washington, D.C. Foreign Fisheries Leaflet No. 12. November, 1971. 16 p.
- Shell, E. W. 1971. Status of Troutculture in Peru. International Center for Aquaculture, Auburn University, Auburn, Alabama 36830. Project: A.I.D./csd-2270. August 15, 1971. 49 p.
- Smitherman, R.O. and D.D. Moss. 1970. Fishculture Survey Report for Peru. International Center for Aquaculture, Auburn University, Auburn, Alabama 36830. Project: A.I.D./csd-2270. September 30, 1970. 41 p.

APPENDIX

Table 2. List of some fishes from the Peruvian Amazon Region in the vicinity of Iquitos*

<u>Common Name</u>	<u>Family</u>	<u>Scientific Name</u>
	<u>Arapaimidae</u>	
1. Paiche		<u>Arapaima gigas</u>
	<u>Osteoglossidae</u>	
2. Arahua		<u>Osteoglossum bicirrhosum</u>
	<u>Characidae</u>	
3. Gamitana		<u>Myletes bidens</u>
4. Paco		<u>Colossoma bidens</u>
5. Sabalo		<u>Brycon sp.</u>
6. Boquichico		<u>Prochilodus amazonensis</u>
7. Yaraqui		<u>P. insignis</u>
8. Puca huicsa (barriga roja)		<u>Tetragonopterus sp.</u>
9. Ractacara		<u>T. argenteus</u>
10. Yulilla		<u>Anodas latior</u>
11. Denton		<u>Rhomboides gibbosus</u>
12. Sardina		<u>Troportheus angulatus</u>
13. Sardina		<u>Chalcinus elongatus</u>
14. Chambira challua		<u>Rhoamphiodon vulpinus</u>
15. Shuyo		<u>Hoplias malabaricus</u>
16. Fasacuy		<u>H. macrophthalmus</u>
17. Quiruchallua		<u>Acestrorhynchus microlepis</u>
18. San Pedro		<u>Abramites microcephalus</u>
19. Liza		<u>Leporinus bimaculata</u>
20. Liza		<u>L. fasciatus</u>
21. Palometa		<u>Mylossoma maculatus</u>
22. Palometa		<u>Metynnis sp.</u>
23. Palometa		<u>Mylossoma aureum</u>
24. Mojarra plateada		<u>Ctenobrycon spilurus</u>
25. Mojarra		<u>Hemigrammus ocellifer</u>
26. Mojarra		<u>H. pulcher</u>
27. Mojarra trompa roja		<u>H. rhodostomus</u>
28. Mojarra		<u>Amphyocharax sp.</u>
29. Mojarra oligolepis		<u>Moenkhausia oligolepis</u>
30. Pez banderita		<u>Hyphessobrycon sp.</u>
31. Mojarra		<u>H. heterorhabdus</u>
32. Mojarra rosada		<u>H. rosaceus</u>
33. Piaba; neon tetra		<u>H. innesi</u>
34. Pechito		<u>Gasteropelecus levis</u>

*Data supplied by Ministry of Fisheries.

Table 2.--continued

<u>Common Name</u>	<u>Family</u>	<u>Scientific Name</u>
	<u>Characidae</u>	
35. Martas		<u>Carnegiella marthae</u>
36. Zapatero		<u>C. strigata</u>
37. Pana roja		<u>Serrasalmo spilopleura</u>
38. Pana blanca		<u>S. rhombeus</u>
39. Pana negra		<u>Pugocentrus scapulares</u>
40. Torpedo negro		<u>Poecilobrycon auratus</u>
41. Torpedo rojo		<u>Nannostomus trifasciatus</u>
42. Oblicuas		<u>Thayeria oblicua</u>
43. Hemiadus		<u>Hemiadus semitaeniatus</u>
44. Copeina		<u>Copeina arnoldi</u>
45. Copeina		<u>C. guttata</u>
46. Pez vidrio		<u>Prionobrama filigera</u>
47. Yahuarachi		<u>Curimatus sp.</u>
	<u>Cichlidae</u>	
48. Tucunare		<u>Cichla ocellaris</u>
49. Acarahuazu		<u>Astronotus ocellatus</u>
50. Anashua		<u>Crenicichla lacustris</u>
51. Bufurqui		<u>Cichlasoma festivum</u>
52. Bufurqui		<u>C. severum</u>
53. Bufurqui		<u>Aequidens portalegrensis</u>
54. Escalar o pez angel		<u>Pterophyllum scalare</u>
55. Apistograma		<u>Apistogramma sp.</u>
	<u>Callichthyidae</u>	
56. Shiruy		<u>Corydoras aeneus</u>
57. Shiruy		<u>C. arcuatus</u>
58. Shiruy		<u>C. hastatus</u>
59. Shiruy		<u>C. elegans</u>
60. Shiruy		<u>C. julii</u>
61. Shiruy		<u>C. rabauti</u>
62. Shiruy		<u>C. melanistius</u>
63. Porjol		<u>Callichthys callichthys</u>
64. Porjol		<u>Hoplosternum thoracatum</u>
65. Maparatre		<u>Hypophthalmus edentatus</u>
	<u>Pimelodidae</u>	
66. Challacagllu		<u>Sorubim sp.</u>

Table 2.--continued

<u>Common Name</u>	<u>Family</u>	<u>Scientific Name</u>
<u>Pimelodidae</u> --continued		
67. Zungaro dorado		<u>Pseudopimelodus</u> sp.
68. Hacha cubo		<u>Sorubimichthys</u> sp.
69. Potolomocunchi		<u>Pimelodus</u> sp.
70. Novia cunchi		<u>Trachicorystes</u> sp.
71. Bagre		<u>Mystus tangara</u>
72. Cunchi		<u>Pimelodella gracilis</u>
73. Doncella		<u>Pseudoplatystoma</u> sp.
<u>Loricaridae</u>		
74. Carachama		<u>Pterygoplichthys multiradiatus</u>
75. Lagarto carachama		<u>Hemiancistrus arenarius</u>
76. Carachama amarilla		<u>Chaetostoma lineopunctata</u>
77. Shitari		<u>Loricaria parva</u>
78. Farlowella		<u>Farlowella</u> sp.
79. Limpia vidrio		<u>Otociclus affinis</u>
<u>Gymnotidae</u>		
80. Angila electrica		<u>Electrophorus multivalvulus</u>
81. Macana		<u>Gymnotus carapo</u>
82. Macana		<u>Hypopomus artedi</u>
83. Macana		<u>Eigenmannia virescens</u>
<u>Synbranchidae</u>		
84. Atinga		<u>Synbranchus marmoratus</u>
<u>Dasyatidae</u>		
85. Raya		<u>Potamotriga histrix</u>
<u>Sciaenidae</u>		
86. Corvina		<u>Plagioscion squamosissimus</u>

ITINERARY

- March 2 Arrived Lima, Peru
- March 3 Conferences with officials of U. S. A. I. D. and the Ministry of Fisheries to arrange work plans
- March 6 Conferences with officials of U. S. A. I. D., the Ministry of Fisheries, and the United Nations Development Program (Fisheries Project)
- March 7 Lima to Cuzco*
- March 8 Cuzco
- March 9 Cuzco to Puerto Maldonado, Cachuela Fish Farm near Pto. Maldonado
- March 10 Lake Sandoval
- March 11 Lake Valencia
- March 13 Inspection of potential sites for fishculture development near Pto. Maldonado
- March 14 Conferences with officials of Junta De Obras Publicas, Departamento De Madre De Dios, Pto. Maldonado regarding future fisheries development plans
- March 15 Pto. Maldonado to Quince Mil
- March 16 Quince Mil to Lima
- March 17 Conferences with officials of the Ministry of Fisheries and U. S. A. I. D.
- March 18 Lima to Iquitos**
- March 20 Loreto Fisheries Station, Quisto Cocha Lake; Privately operated fish ponds
- March 21 Cashu-cocha, Zungaro-cocha and Caballo-cocha Lakes on Nanay River
- March 22 Iquitos - Discussions on pen culture experiments with biologists

*Accompanied by: Blg. Jose Mathos and Sr. Carlos Diaz

**Accompanied by: Blg. Miguel Castaneda R. and Blg. Oridio Correa Ponce

- March 23 Iquitos - Discussions with biologists on construction of aquacultural stations
- March 24 Inspection of ponds and potential pondculture sites near Iquitos including Pampa Chica and Penanegra
- March 25 Iquitos to Nauta by motorboat;
Inspection of ponds and potential pondculture sites near Nauta;
Return to Iquitos
- March 27 Inspection of potential fish pond sites near Iquitos;
Acuario Morona Cocha S.A., exporter of ornamental fishes
- March 28 Iquitos to Lima
- March 29 Final conferences with officials of the Ministry of Fisheries, U.S.A.I.D. and UN/FAO; Fisheries Department of La Molina University
- March 30 Departed Peru