



PD/A CRSP SIXTEENTH ANNUAL TECHNICAL REPORT

NEW SITE DEVELOPMENT AND CHARACTERIZATION—PERU

*Eighth Work Plan, Peru Research 2 (PR2)
Final Report*

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ABSTRACT

This report is a descriptive overview of the South American PD/A CRSP site located at the Instituto de Investigaciones de la Amazonia Peruana research facility in Iquitos, Peru, and contains information pertaining to the physical, geological, meteorological, and hydrological characteristics of the region. The facility is located in a densely populated region that has undergone significant commercialization, industrialization, and subsequent deforestation. The region surrounding the facility ranges from an elevation of 100 to 120 m above sea level and the soil is composed of sand in a mixture with clay and a slight amount of silt. The regional climate is tropical; the average temperature is 26.5°C; annual precipitation of the region is greater than 2,500 mm; and maximum sunshine hours range from 11 h 36 min to 12 h 38 min. The Amazon River levels fluctuate between 107 and 118 m, flooding nearly 10 m. The research facility is located at an elevation high enough to avoid the flooding common to the region. As a result of precipitation there are three categorizations of water chemistry in the Amazon region: white, clear, and black. White water is turbid with silt particles, ochre-colored, has transparencies (Secchi disk depth) of 0.10 to 0.50 m, and pH ranges from 6.2 to 7.2; clear water is more transparent (Secchi disk depth) of 1.10 to 4.30 m green to olive-green in color, and pH ranges from 4.5 to 7.8; black water is mostly transparent (Secchi disk depth) of 1.30 to 2.90 m, olive-brown to coffee-brown in color, and pH ranges from 3.8 to 4.9. The research ponds exhibited chemical properties characteristic of white and black water categorizations and their water was classified as soft and slightly acidic. Water temperature ranged from 29.3 to 31.7°C; DO averaged in excess of 4.0 mg l⁻¹; total ammonia nitrogen was < 1 mg l⁻¹; carbon dioxide reached as high as 22 mg l⁻¹; and average transparency ranged between 29 and 125 cm. Additionally, the report describes the research facility's flow-through system, research ponds, and additional infrastructure.

INTRODUCTION

The Eighth Work Plan in Peru has been in effect since 1996. The project has taken place at the Instituto de Investigaciones de la Amazonia Peruana (IIAP) research facility. The facility is established within a natural area, and has remained simple in nature, consisting of a few small one-story buildings and 25 irregularly shaped research/culture ponds. Since the beginning of this project, the facility has undergone major renovations for the

improvement of aquaculture studies. The facility is still under renovation and in the process of acquiring new research equipment, but will soon be capable of recording all data necessary to complete project requirements. A descriptive overview of the facility and the area of Iquitos, Peru, including physical and geological descriptions, hatchery and ponds descriptions, and meteorological and hydrological descriptions, has been developed for this Eighth Work Plan report based on data collected or obtained from references from accredited sources.

Legend to the physical layout of IIAP CRI-Loreto research facility at Iquitos, Peru, 1997

1. 3,100-m² pond
2. 650- m² pond
3. 1,347-m²; 1,368-m³ pond
4. 1,198-m²; 1,532-m³ pond
5. 1,158-m²; 1,278-m³ pond
6. 1,015-m²; 900-m³ pond
7. 600-m² pond
8. 600-m² pond
9. 600-m² pond
10. 2,443-m² pond
11. 1,408-m² pond
12. 2,642-m² pond
13. 5,320-m²; 4,490-m³ pond
14. 2,940-m² pond
15. 1,000-m² pond
16. 1,000-m² pond
17. 60-m² ponds (nine)
18. Offices/housing
19. Water tower (well)
20. Laboratory
21. Administration
22. Service Building (storage)/feed lab
23. Supply and tool house
24. 45- and 50-m³ cisterns
25. Fish hatchery

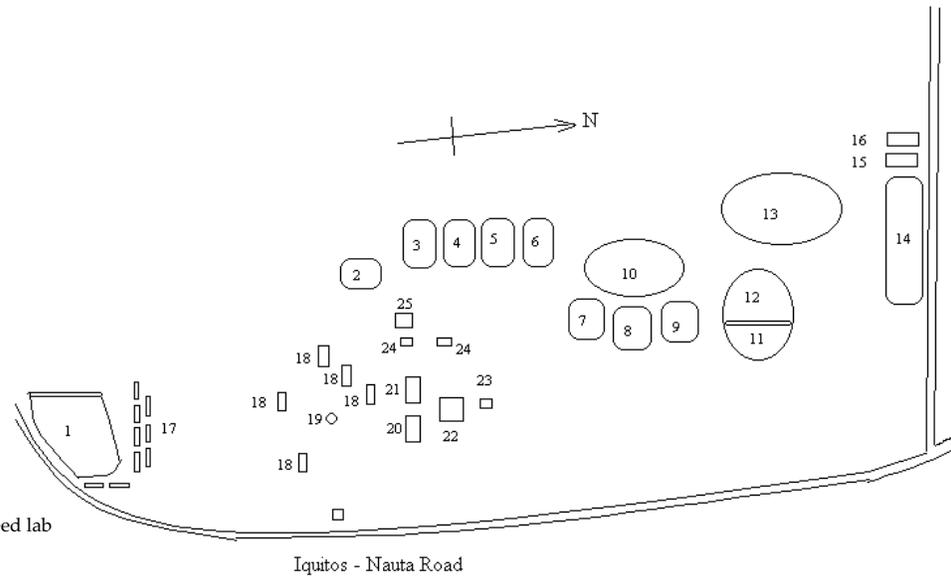


Figure 1. Physical layout of the IIAP CRI-Loreto research facility at Iquitos, Peru, 1997.

PHYSICAL AND GEOLOGICAL DESCRIPTION

The Eighth Work Plan study site is located at the Instituto de Investigaciones de la Amazonia Peruana (IIAP) Centro Regional de Investigaciones-Loreto (CRI-Loreto), a regional research site. This facility is located 7 to 10 km southeast of Iquitos, Peru ($-3^{\circ}45'10''$ latitude and $-7.3^{\circ}11'29''$ longitude). The local time, during fall and winter, matches the United States Eastern Time Zone and during spring and summer matches the Central Time Zone. The region is heavily populated relative to the rest of the lowland forest region, with an estimated human population of approximately 300,000 inhabitants. Consequently, commercialization and industrialization in the area have led to significant deforestation. Secondary succession tropical forests are predominant in this region. Natural undisturbed rainforest is sustained approximately 20 to 30 km from Iquitos. The IIAP CRI-Loreto facility is located in the outskirts of Iquitos. This region is sloping and full of hills, ranging in altitude from 100 to 120 meters above sea level. Most of this area is declared floodplain since it divides the Itaya and Nanay tributaries to the Amazon River. It is built within a densely vegetated area on a land gradient suitable for gravity-fed ponds. The facility consists of several buildings serving different purposes (e.g., offices, labs, storage, and hatchery) and irregularly shaped ponds fed by rainwater contained in two cisterns and an artesian well-fed water tower used as an auxiliary source (Figure 1). Soil samples were collected in March 1997 and were sent to be analyzed at Auburn University. Dr. Wes Wood will be collecting more soil samples in August 1998 for additional analyses. Soil composition is predominantly sand in a mixture with clay and a little silt. Soil and terrain suitability for aquaculture ponds in this region was diagnosed by Kapetsky and Nath (1997) as moderately suitable (slope = 2 to 8%; effective soil depth 75 to 150 cm; gravel and stones 40 to 80%; soil and texture loamy or clayey without swell-shrink, and not organic; salinity 4 to 8 dS m⁻¹; pH 5.5 to 7.2; catclays not present; gypsum not present).

HATCHERY FACILITY AND PONDS

The hatchery facility at CRI-Loreto is approximately 65 m² and is equipped with a sand-based mechanical filter, six 200-US-gallon concrete brood tanks, twelve 30-l jar incubating system with a 40-US-gallon fry receptacle, a laboratory table, cabinets, and counter top with sinks for prep work.

Water is gravity fed throughout the facility. Water is fed into the hatchery from two cisterns (45 and 50 m³) and then down through a custom built mechanical sand filter that removes large particles from the water. Water then flows through the six brood tanks and egg incubating system out the hatchery via grooved concrete ground channels into the ponds at lower elevation. The entire facility is a flow-through system with water being most abundant during rainy seasons. The incubator has a European design which allows water to flow from beneath the jars out through an upper lip. Adjusted pressure allows the eggs to remain revolving in the water column until the hatching period. Free-swimming fry eventually swim out the lip into the fry receptacle, where they are collected and stocked into grow-out ponds. Ponds throughout the facility are irregularly shaped and vary in size. They are filled primarily by rain and water from the cisterns, but the construction of an artesian well and elevated water tank will soon aid in pond filling during drier seasons. There are nine 60-m² rectangular fry ponds and sixteen grow-out and brood ponds, ranging from 600m² to 5,320 m². The area surrounding the ponds is sandy, covered with well-trimmed grass, palm trees, almond trees, and fruit trees around the levies, and with secondary succession forest bordering the whole facility. The water is predominantly black (some ponds may turn muddy or turbulent due to clay and silt in the substrate), slightly acidic, and soft. Irregular shapes of some ponds lead to high concentrations of macrophytes resulting from flat banks with mild slopes. Substrate composition varies among the ponds. During dry seasons, evaporation and infiltration through sandy sediment become an important issue

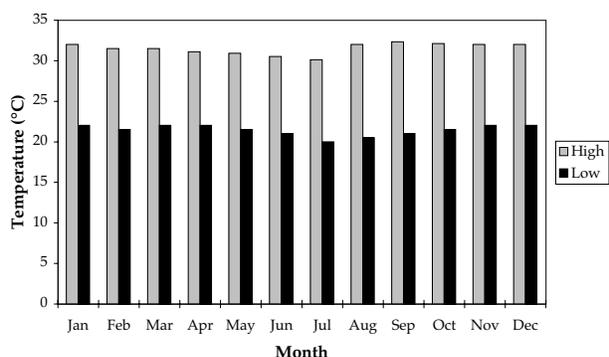


Figure 2. Average monthly ambient temperature range of Iquitos, Peru.

due to reliance upon rain to maintain water levels in the ponds. When the well becomes operational, this situation will be improved. Feed for the fish is prepared from raw ingredients at the feed lab. The ingredients are stored in the storage facility under cooled conditions to prevent denaturing. The prep room is equipped with weighing balances and an industrial custom-built pelletizer. After measuring, the ingredients are mixed in a wheelcart, then pelleted through the pelletizer. Finally, the feed is sun-dried until ready for use.

METEOROLOGY

The regional climate is tropical. It is hot and humid most of the year with an average temperature near 26.5°C (Figure 2). Average wind speed at the research facility was 1.6 km hr⁻¹ this year. Maximum sunshine hours in the Amazon region are constant, ranging from 11 h 36 min to 12 h 38 min, although sunshine hours at the surface are lower due to high humidity leading to cloud formation, which also decreases solar radiation at the surface by 50%. (Salati and Marques, 1984). Average surface sunshine hours were calculated to be 3.0 h d⁻¹ at the research facility. Annual precipitation in the Iquitos region, as well as the continuous western Amazon, surpasses 2,500 mm (Dumont and Garcia, 1992). In Iquitos most of this rain occurs between January and June (Figure 3).

HYDROLOGICAL CYCLE AND WATER TYPES

Changes in seasonal precipitation have an immense impact on river level fluctuations throughout the year. The Amazon River levels at Iquitos fluctuate between 107 and 118 m above sea level throughout the year (Amazon Hydrography and Navigation Service, 1997; see Figure 4). The region floods nearly 10 m during flood season. The CRI-Loreto facility is located on ground sufficiently high to prevent the frequent

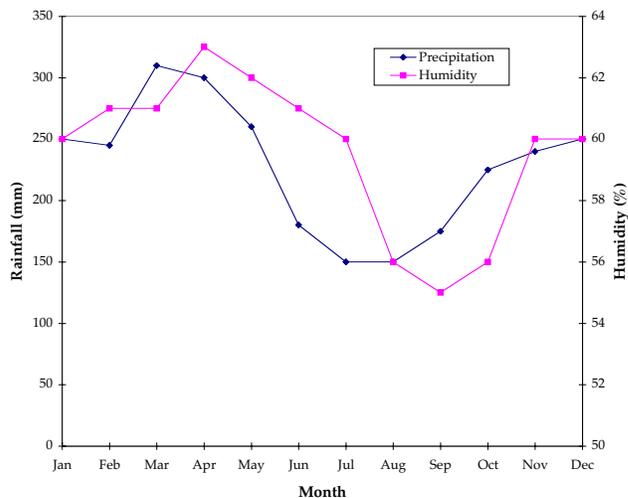


Figure 3. Average monthly precipitation and humidity at Iquitos, Peru.

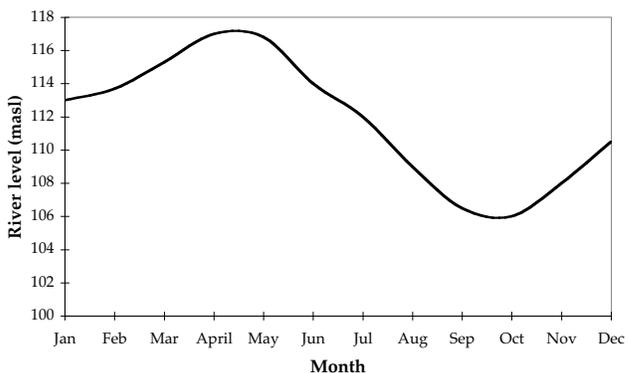


Figure 4. Amazon River annual hydrological cycle at Iquitos, Peru. Level fluctuation is directly related to rainfall. Information provided by the Amazon Hydrography and Navigation Service.

flooding common to the region. At the research facility, the rainy season triggers the time to fill the culture ponds and when certain species such as *Piaractus brachyomus* and *Colossoma macropomum* prepare to spawn. This precipitation increment also affects the water chemistry in rivers and ponds. Three types of water are described in the Amazon region: white, clear, and black waters (Sioli, 1984). Each type exhibits different chemical and physical properties. White water is turbid with silt particles, ochre-colored, and has transparency (Secchi disk depth) of 0.10 to 0.50 m, and pH ranging from 6.2 to 7.2. Clear water is more transparent

Table 1. Early morning water quality levels^a of ponds used in the Eighth Work Plan at the IIAP CRI-Loreto research facility Iquitos, Peru, 1997 to present.

	Temperature	O ₂	CO ₂	pH	TAN ^b	Chloride	Conductivity	Alkalinity	Hardness	Transparency
Mean	29.2	4.9	7.2	6.7	< 1	8.6	96.0	20.0	20.0	104.3
High	28.8	0.5	22.0	7.6	< 1	40.0	200.0	20.0	20.0	125.0
Low	31.8	10.5	2.0	6.0	< 1	4.0	10.0	20.0	20.0	29.0

^a Values in mg l⁻¹ except temperature (°C), pH, conductivity (μ ohms cm⁻²), and transparency (cm).

^b TAN = total ammonia nitrogen.

(1.10 to 4.30 m), green to olive-green, and has pH ranging from 4.5 to 7.8. Black water also is more or less transparent (1.30 to 2.90 m), with olive-brown to coffee-brown coloration and pH ranging from 3.8 to 4.9. All three types are found in the Iquitos region.

WATER QUALITY

The ponds at CRI-Loreto exhibited a mixture between white and black water properties during the Eighth Work Plan study (Table 1). Mean maximum and minimum temperatures were 31.7 and 29.3°C, respectively. Minimum dissolved oxygen levels generally remained above 1.0 mg l⁻¹, and usually averaged in excess of 4.0 mg l⁻¹. Total ammonia nitrogen (TAN) remained below 1.0 mg l⁻¹ while carbon dioxide levels reached a high of 22 mg l⁻¹. These waters can be classified as soft (hardness = 20 mg l⁻¹; alkalinity = 20 mg l⁻¹; conductivity = 96 µohms cm⁻²) and slightly acidic (morning pH ranging from 6.3 to 7.1). Average transparency ranged between 29 and 125 cm.

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