THE IMPORTANCE OF MANGROVES IN SUSTAINING FISHERIES AND CONTROLLING WATER QUALITY IN COASTAL ECOSYSTEMS

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Program in Science and Technology Cooperation

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Progress and Data Report
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PROGRESS REPORT

I. Project Overview and Objectives:

Mangroves are forested wetlands that inhabit the intertidal zone of tropical and subtropical estuaries. It has been suggested that these wetlands provide both food and habitat for a diverse fishery, and that the yields of some commercially important species are dependent on the area of this vegetation along the coastline. These forests may also serve as either a nutrient source or sink, and influence the fate of sediments in estuarine ecosystems. Because of the possible importance of mangroves to the coastal zone, human activities such as forestry, aquaculture, agriculture and residential development that impact this natural resource are of concern to coastal zone managers. Mangroves have received considerable botanical investigation, yet little is known concerning the ecology of these ecosystems. A better understanding of the function of mangroves relative to their contribution to the organic matter and nutrient budgets of estuaries is needed for development of best management plans for the coastal zone. This mangrove research project in Ecuador and Mexico is part of a continuing effort to understand the ecology of mangrove ecosystems.

The goal of this research program is to investigate specific mangrove properties under different types of geomorphology. Predictions of ecosystem function based on models of mangrove processes are presently restricted to specific environmental settings. Thus the application of mangrove management practices from one part of the tropics to another is limited by a general understanding of mangrove ecology. The following are the proposed objectives and tasks of this project based on the hypotheses stated above:

1. To measure organic matter production and transport in different types of mangrove forests under various tidal and fertile conditions to better define the function of these wetlands in tropical estuarine ecosystems;
2. Determine the importance of nutrient accumulation (burial) and denitrification in mangroves to losses of nutrients from estuarine ecosystems;
3. Determine if mangroves are a net source or sink of nutrients in estuarine ecosystems;
5. Determine the utilization of mangroves for habitat and food by economically important fisheries.

II. Program Organization and Personnel

The following personnel have been supported at the University of Southwestern Louisiana partly from funds from this project:

Robert Twilley - Principal investigator in charge

of the project. Support includes summer salary.

James Lynch - Research assistant responsible for the determination of sedimentation rates in mangroves. Support includes 10% of full time salary.

Karen Tychsen - Clerical and technical support of the program.

Monica Solar - Technical support in laboratory.

Victor Rivera-Monroy - Graduate student working on PhD thesis concerning denitrification in mangrove forests.

Mireya Pozo - In charge of forestry field program in Ecuador.

Victor Garcia - Assists in the forestry field program; responsible for hydrology and groundwater measurements.

Washington Cardenas - In charge of nutrient sampling and analysis in estuary program; analysis of phytoplankton populations.

Nikita Gaibor - Assists in both forestry and estuary programs; responsible for natural isotope abundance in nekton.

Jorge Espinoza - Assists in estuary program analyzing samples of particulate material.

II. Project Accomplishments to Date:

1. Site Selection and Logistics

a. Mangrove sites:

Ecuador - The mangrove forests at Churute Mangrove Preserve have been classified by tree heights into three categories: M1 - trees > 15 m; M2 - trees 7 to 15 m; M3 - trees < 7 m. This classification system was developed by CLIRSEN and the ecological preserve has been mapped and areas of forest within each classification determined. The project has established studies of litter production in each of the three types of forests (Figure 1). Studies in the M3 site began in February 1989, while the other two sites were set up in June 1989. All three types of mangrove forests in the Churute Preserve are dominated by Rhizophora harrisonii and R. mangle.

Mexico - Sites in Terminos Lagoon were described in the proposal and include a fringe and basin mangrove forest in Estero Pargo, and a riverine site in Boca Chica. Other sites may be considered for expansion of present studies in Terminos Lagoon.

b. Estuary sites: Monthly surveys of selected chemical, physical and biological characteristics of the Guayas River estuary have been conducted at 21 stations aboard the RV Proteo (Figure 2). Chemical and physical measurements were taken at all 21 stations while fish and shrimp populations were sampled only at 9 stations. There have been 5 cruises to date and each cruise is three days during the full moon: (1) 1 June 1989, (2)

17 July 1989, (3) 12 October 1989, (4) 15 November 1989, (5) 18 December 1989.

2. Phenology (Ecuador): Measurements have begun in the M2 and M3 sites on the phenology of Rhizophora sp. (Appendices A and B, respectively). Branches on each of four trees have been tagged and the changes in presence of leaves, fruits, and flowers have been observed on monthly basis. Measurements are also made on the length and diameter of branches.

3. Mangrove Litter Dynamics:

Ecuador - Ten litter baskets (0.25 m^2) have been randomly placed in the M1, M2 and M3 mangrove forests in the Churute Ecological Preserve. Collections have been made biweekly and results are given in Appendices C, D, and E, respectively. In addition, measurements were made on the accumulation of litter on the forest floor in each of the three sites (Appendices F, G, and H, respectively).

Mexico - Litter collections are part of a continuing program in Terminos Lagoon in Estero Pargo. Collections have been made biweekly for the last 12 months in a fringe and basin mangrove forest, and prepared for nutrient analyses in Dr. Twilley's laboratory at USL.

4. Hydrology:

Ecuador - Measurements in each forest include water depth, salinity of surface and pore waters, and precipitation (Appendix J). In January 1990 a water level recorder was set up in M3 site in the preserve. This recorder will be operated for 3 days during the new and full moon periods of each month.

5. Climatology:

Ecuador - Monthly measurements of important climatological information such as wind speed, solar radiation, humidity, precipitation and evaporation potential are collected by a military installation adjacent to the preserve and copied monthly by one of the students (Appendix O).

6. Sedimentation:

Ecuador - Chemical (percent carbon and nitrogen) and lead-210 analyses have been completed on two cores that were collected in the M3 mangrove site in May 1989 (Appendix I). Two cores were sampled in January 1990 in each of the M1 and M2 sites for similar analyses.

7. Denitrification and Nitrogen Fixation:

Experiments were performed in a local forested wetland on the campus of USL to further develop techniques for the measurement of denitrification in mangrove forests. These techniques concentrated on the use of acetylene blockage to

determine denitrification rates.

Ecuador - Preliminary experiments on denitrification were performed in January 1990 in the M2 and M3 mangrove sites in Churute. The acetylene blockage technique was used with small intact cores to determine ambient denitrification rates.

Mexico - Mr. Victor Rivera-Monroy will be leaving for Mexico in February 1990 to begin an preliminary studies of denitrification in mangroves in Laguna de Terminos. His thesis project is being partially supported by this project.

8. Estuarine Nutrient Cycling:

Ecuador - Monthly cruises (five) on selected chemical, physical and biological characteristics of the Guayas River estuary were performed at the 21 stations described above. Results for chlorophyll a, dissolved oxygen and particulate material are given in Appendix K, and results for nutrients are given in Appendix L. Identification and density of phytoplankton and nekton are given in Appendix M and N, respectively.

9. Detritus Utilization:

Ecuador - Samples from a preliminary survey in May 1989 of the natural isotope composition of a variety of samples from the mangrove and estuary systems of the Churute Mangrove Preserve have been assayed for total carbon and nitrogen content. These samples will be assayed at the natural isotope laboratory at Woods Hole Oceanographic Institute under the direction and consultation of Dr. Brian Fry.

IV. Project Problems:

This ecosystem study of the mangroves in the Churute Ecological Preserve has developed into a major research effort that involves the cooperation of several institutions. Major funding for the study is from the Science and Technology Committee, while other institutions have provided personnel time in clerical and technical support, and transportation. Because of the cooperative nature of these institutions, such as the University of Rhode Island Coastal Resource Management Project, District Forestry Office in Guayaquil, University of Guayaquil, and National Fisheries Institute in Guayaquil, the information content of this study is much larger than originally designed.

There have been some problems with the estuary field program. Cruises were originally designed to occur monthly beginning in July 1989, yet there have been only five cruises through January 1990. During a recent trip in January 1990, INP reaffirmed their commitment to the success of the estuary field program. It is anticipated that cruises will continue monthly until August 1990.

V. Tasks for Next Reporting Period:

1. Litter Productivity and Phenology:
Ecuador - Continue collections in M1, M2 and M3 sites; prepare collections for nutrient assay. Preliminary studies of litter decomposition and utilization by crabs will be initiated in M3 site.
Mexico - Continue collections in Estero Pargo; begin nutrient assay of some collected samples.

2. Estuarine Nutrient Cycling (Ecuador): The 21 station surveys of the Guayas River estuary should continue in February 1990 and continue for 6 months.

3. Denitrification and Nitrogen Fixation: Mr. Rivera-Monroy will begin studies of denitrification in Mexico and during June 1990 will attempt another set of experiments in Ecuador.

4. Sedimentation (Ecuador): During the next six months work will continue on the assay of Pb-210 on the sediment cores collected in M1 and M2 mangrove sites in Churute Ecological Preserve in January 1990. Additional analyses on these core sections will include total carbon, nitrogen and phosphorus.

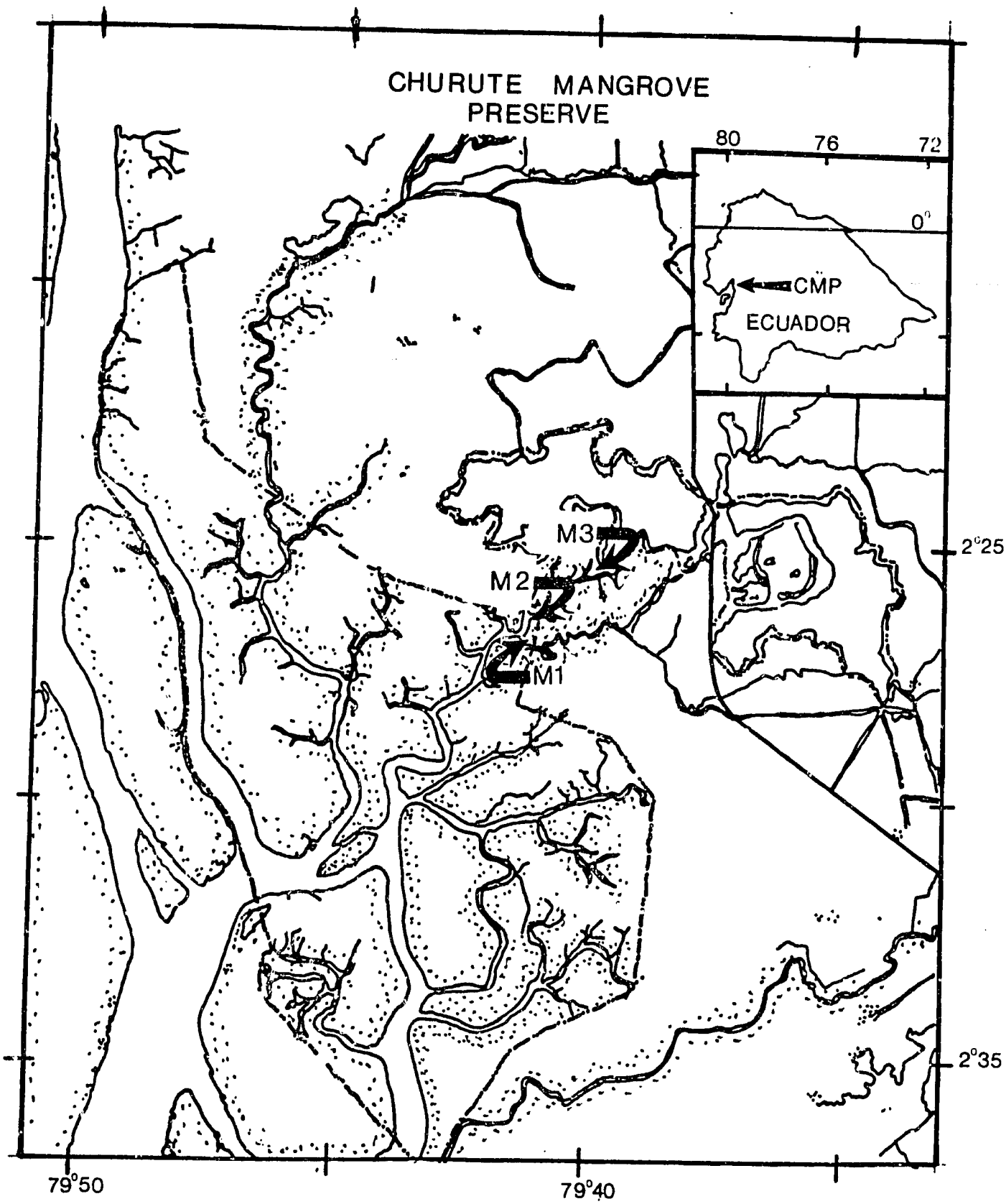
5. Detritus Utilization (Ecuador): Samples of nekton from surveys of the Guayas River estuary will be prepared for assay of natural isotopes of carbon, nitrogen and sulfur at WHOI isotope laboratory by Dr. Brian Fry.

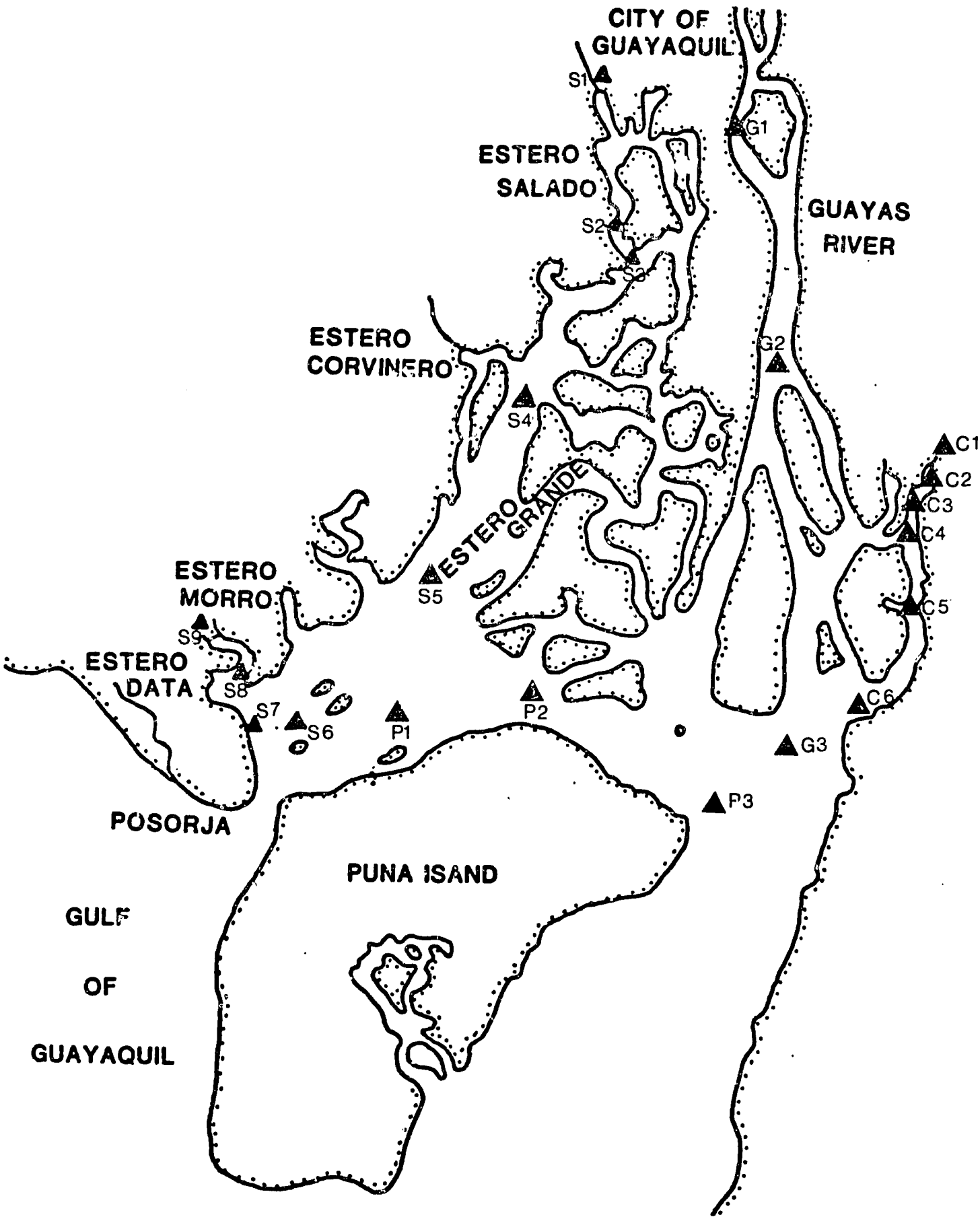
VI. Publications and Presentations:

University of Rhode Island, 6 October 1989. "Ecology of Mangroves in the Churute Ecological Preserve, Ecuador."

University of North Carolina - Chapel Hill, 2 September 1989. System Ecology Symposium. "Properties of Mangrove Ecosystems."

Dauphin Island Sea Lab, Alabama, 1 August 1989. "Nutrient Recycling in Coastal and Offshore Ecosystems."


CHURUTE MANGROVE
PRESERVE
80
76
72
0°
CMP
ECUADOR
M3
M2
M1
2°25
2°35
79°50
79°40


CITY OF GUAYAQUIL
S1
G1
ESTERO SALADO
S2
S3
GUAYAS RIVER
ESTERO CORVINERO
G2
S4
C1
C2
C3
C4
ESTERO GRANDE
S5
ESTERO MORRO
S9
ESTERO DATA
S8
S7
S6
P1
P2
C5
C6
G3
P3
POSORJA
PUNA ISAND
GULF OF GUAYAQUIL

DATA REPORT

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APPENDIX C: Litterfall in the M1 mangrove site in the Churute Ecological Preserve.

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APPENDIX I: Concentrations of Pb-210, nitrogen and carbon in sediments in the M3 mangrove site in the Churute Ecological Preserve.

APPENDIX J: Depth of surface water and concentrations of salinity in groundwater at the M1, M2 and M3 mangrove sites in the Churute Ecological Preserve. Measurements are made at four locations and four depths at each station: S = surface; A = 0.25m; B = 0.5 m; C = 1.0 m.

APPENDIX K: Concentrations of chlorophyll a, dissolved oxygen, salinity and suspended particulate material in the estuary in Churute Ecological Preserve and Estero Salado.

APPENDIX L: Concentrations of nutrients in the estuary in Churute Ecological Preserve and Estero Salado.

APPENDIX M: Identification and density of phytoplankton in the estuary in Churute Ecological Preserve and Estero Salado.

APPENDIX N: Identification, density and length of nekton in the estuary in Churute Ecological Preserve and Estero Salado.

Names and addresses for AID Mangrove Reports:

1. Office of Science Advisor (1 copy)
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