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ANNUAL REPORT

TERRESTRIAL ECOLOGY DIVISION

FY ? 1979

CENTER FOR ENERGY AND ENVIRONMENT RESEARCH

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TERASSTRIAL POOLOGY DIVISION

AMWUAL REORT FY-1979

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Mission of Terrestrial Ecology Division

The Terrestrial Ecology Division is dedicated to the acquisition of an understanding of ecosystems in order to permit a rational development and planned utilization of natural resources. Of particular importance is the resource of energy and studies are carried out to further the understanding of this resource development in Puerto Rico as well as in the Continental United States. The goals of this mission overlap considerably, as will be evident from the project descriptions.

Structure and Function of Tropical Ecosystems

The foremost goal of the Division is to develop an understanding of the structure and processes charac-

teristic of tropical ecosystems for the purpose of pre-

@iceing which features are sensitive to natural and

anthropogenic changes. In particular, the Division has
focusdésa its efforts on the El Yunque Tropical Rain
Forest and its associated drainage basin. It is reareded
that 2 sufficiently detailed description of the structure
and function of this main forested watershed and its
drainage system will provide a model to indicate which

subsysteme are Likely to be impacted adversely by energy

development and utilization and related activities,

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One of the continuing objectives of the studies
realized in the forest and drainage basin is to compare
structural and functional Features of this ecosystem

th other ecosystems located in Puerto Rico and abroad,
Another objective has been to devise and carry out field
Perturbation experiments to determine how changes in
structural and process features of the ecosystem are re-
lated to altered environmental conditions.

Ecological Es

cts

?A second principal goal of the Division is to

determine the relationships between ecological effects

at all levels of organization and energy and other re-

source development.

The energy efficient control of pests, Land-side distribution of wastes and modern methods of pollution control may contribute to long range ecological effects. These effects, per se, may or may not be directly related to energy problems but do relate to energy utilization, Consequently the Terrestrial Ecology

Division has very recently begun to establish objectives leading to the goal of prediction of long term undesirable ecological effects which at worst could be irreversible, Basically these objectives are as follow

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1, To determine the "aseint

ative capacity"

of different representative ecosystems to

and specific perturbants.

2, To examine and qualify relationships between ecological effects and quantitative bio

assays

4 other measurements.

3, To evaluate the relative influence of:

"

spatial variability, sampling error, measurement errors and sampling effort on detectability of the potential effect.

Resource Management and Conservation

?The most recently developed goal of the Division

As to develop information necessary for the management of environmentally important resources such as land, water and wild life, Within the past 2 years, the Division has actively sought local and national roles leading to the application of its background in environmental research to help identify and resolve both short term and long range problems in both the public and private sectors.

?The general objectives for realization of this

1. To evaluate alternative methods for water

reclamation in an effort to maximize energy

---Page Break---

efficiency, economy and recovery.

To evaluate alternative methods for land

space reclamation which complement the att

3. To exa

ne and describe factors Saportant ia
the survival ant well-heing of biotic resources
of econowic and esthetic importance to man.

Projects

A weries of projects have bean wholly or partially

executed to satisfy the goals and objectives «rated, A

short list and description of sach follows:

e and Process Suudies

(er)

?The National Environmental Research Park (NERP)

onal_Environmental Research Park

program was funded by the U.S. Department of Energy

(DOE) and Commonwealth of Puerto Rico Conservation Trusts!

it is dedicated to the selection and characterization of certain sites which can be set aside and reserved for purposes of ecosystem research. A site receiving DUE approval will be managed for specific studies related to environmental impacts due to energy generation and utilization, Long term comparison with ecume

valent sites (possibly also NERP sites) would then be

practical and could be structured to minimize cost and

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and sustain the quan

Y and quality of date avai

for ecosystem changes.

Gseling, Transport and Mobil a

Besinage Hasina.

The a

veral transport study program is part of che

base program of the Division funded by WOE. Measurement

nutrients and changes in nutrients in defined conpart=

faents such as 1

af Litter, soil horizons, tree bark,

primary consumers, ets, can be used to define traneport

Bodels which can thon be operated upon syntherically of

abstractly. Subsequent measurements after perturbation

can denontrate which compartments are most affeeced by

sev-nade perturbations, Examples of field perturbations

include forest irradiation and clear cutting as veil ag

natural disturbances such as hurricanes ané flooding.

Long Ters Ecological Monitoring

This program was undertaken in conjunction with the

NERP program and potential sources of funds include the

NSF Long Term Ecological Res

eh (LTER) Program, it

consists of @ broad based monitoring progras which would

examine long term variability of species composition,

climatic conditions, stre

flow and water quality axons

other parameters used to characterize a tropical rain

forest,

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Industria siting

With the ste

1y increasing world cout of

Petroteus and Puerta Rico's \$95 denendence on peeroleus

for electrical power generation, aiternative fuel-firec

plants are now in the construction panning phase. tee

logical characterization of sites which would be ape

Propriate for the construction of coal-fired plants is required

by Law and the Puerto Rico Flectric Power Authority hes

Fequested the Terrestrial Ecology Division to scope and

carry out studies on several potential sites. Such

studies provice structure and function

different local sites with which date from the E2 Yenque

Tropical Rain Forest may be compared.

gical EF

Cooling System Effects on Aquatic Ecosystems

?The Savannah Riv

Laboratory in South Carolina

is interested in long term effects in water bodies heated above ambient temperature by reactor cooling water, The study realized at the Savannah River Plant will seek to

Tationalize « large amount of structure and process data accumulated for such a water body over the past 20 years.

Intensive Biomass Culture

Little is known about the ultimate effects of

intensive biomass culture upon soil properties, drainage

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3.2.3

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3.32

water quality and insi

operator relationships,

Effects associated with potentially massive dispersion

of fertilizers, pesticides and soil conditioners are

be assessed for intensive production of grasses to be

used for energy production, Potential sources for funding

of this research are: DOE, the U.S. Environmental Protection Agency (EPA), the Puerto Rico Land Authority

and the U.S. Department of Agriculture (USDA).

Water Hyacinth Cover of Water Bodies

The desirability of harvesting water hyacinth

(*Eichhornia crassipes*) from surfaces of water bodies used

as potable water sources

has been under debate for the

past 10 years, The CEER-DOE Development Fund has supported

research aimed at determining nutrient uptake,

Productivity and ecological parameters associated with

water hyacinth mats which currently dominate the surface of Lake Carrafzo, @ local potable water source.

Resource Recovery

Energy Reclamation and Water Purification

A program largely financed through the CEER Development Fund, the Puerto Rico Aqueducts and Sewers Authority, and small grants from local industries has produced

2 projects of applied environmental research, They are

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devoted to the acquisition of data which would find

Direct application in the alleviation of water pollution

and in the use of noxious weed pests for high quality

energy (e.g. methane) generation.

Maver Hyacinth Water Reclamation and Fermentation

This project aims at determining if small well managed water hyacinth lagoons can be used effectively for processing domestic sewage and industrial waste water, It is also concerned with economic advantages of harvesting and anaerobically fermenting water Hyacinth to obtain methane, 2 high quality effluents =

High Gradient Magnetic Filtration (HGMF),

Particularly refractory waste water streams can be

treated more efficiently with respect to energy expenditure Using an advanced separation and clarification technique to remove particulate matter, biochemical oxygen demand and heavy metals, The establishment of this project aims at examining applicability of the technique in Puerto Rico, as well as at long term effects of its application.

Waste Sludge Utilization and Disposal

Of potential interest to EPA, USDA and to local
funding agencies, composting and land distribution of

waste sludge

has associated with it some problems which

are well encompassed by the goals of the Terrestrial

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Geology Division. The waste sludge must be distributed
on land after 1982 by law, Waste sludge, if distributed
in forest ecosystems may represent a serious perturbation
to its structure and function, Waste sludge may be useful
for maintenance of soil productivity and soil structure
during long regimes of intensive biomass cultivation,
Finally, ecological effects of waste composted sludge for
tropical forest cover reclamation has never been studied.

Research Progress Review

Feonysten Structure and Function

During 1979, a critical and extensive review of on-going studies was carried out to determine the requirements of the Division with respect to manpower and the Limitations imposed by the DOE research budget, Studies in the lower drainage basin were concluded and a volume:

"Proceedings of the Seminar on River Basin Planning and

Environmental Planning? was prepared and edited, The

principal conclusions of some of the papers contained

therein were reviewed in the 1978 annual report to the
Advisory Committee of the President of the University of

Puerto Rico. One of the conclusions which was not presented

is as follows.

A drainage basin is not an appropriate

planning unit

in Puerto Rico owing, in part, to the fact that most drainage

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Area

with respect to development and that open areas which

are worthy of a planning effort ar

smelt and generally

widely separated,

Internal reviews of program directions generally

continuous component to the entire Ric

Espirito Santo (Rr

Diver drainage basin will not yield

8 cohesive model of the basin due to limitations on re-

able. However, there are features of the

Luguille National Forest which can receive more attention

ane 1

itation to the forested section of the RES basin
can provide information of importance for comparative
structure and function studies,

For example while limological studies carried
out in the basin do reveal some of the dynamics of mineral
mobilization due to migratory patterns of freshwater
shrimp and crab species, cycling and transport studies
limited to the watershed might be very useful for characterizing
biogeochemical interfacial transport of carbon dioxide.
Atmospheric buildup of carbon dioxide is of worldwide
concern because of its potential impact on climatic
patterns.

Rack

1 Environmental Research Park (NERP) Program

The Terrestrial Ecology Division is proposing that

wo sites, El Taro and El Verde, be included in the

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Department of Energy (DOE) supported initiative? FAVIXON

mental Research Park (NERP) system, AE present this ne

search parks:

nah River Plant, S.C.

One Ridge Sational Lab, of Tenn,

Designation as NERP's will make these lands available

for use as field laboratories in which visiting scientists, staff and university participants may carry out ecological research programs designed to develop the data base necessary to make scientifically reasoned environmental decisions. The focus of this program will be to evaluate the current and potential impacts of man's activities, in particular those related to energy use and development, and will address the following NERP objectives:

1, Continuous and quantitative monitoring and assessment of environmental impacts and development of baseline, but site specific comparable data, by means of networkwide standardized methods (e.g. Meteorological monitoring network, species lists, mapping, population levels, Life histories to identified sensitive species, site manipulation.

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?cpnent of methoes to e:

ate or

predict environneatal response £0 proposed

activitice (e.g. nutrient ond minerat eyetingy

succession, pollutant depesiton...)

3. Dewnstrate impacts to the public and evaluate

natiode to cininize adverse impacts.

A proposal was submitted in June, 1979 co include

El Faro in the NERP network, The 522 acre site ie tocatea

fon the extreme northeastern tip of Puerto Rico near the

of Fajardo and is privately omed by the Conservation

?Trust. This group contacted the Terrestrial Ecology Division to characterize the site and evaluate its potential as a NERP. Preliminary vegetation and faunal surveys were completed in the fall of 1978 and field work for three theses from UPR was conducted on-site. Included at #1 Faro

are a wide range of habitat type:

beaches, rocky shores,

Bangrove forests, a coastal lagoon, abandoned palm plantations, and xerophytic forest. These types are similar to those being adversely impacted in the coastal zone

island-wide, making

Faro an ideal reference area and site for ecological research.

?A second site, Ei Verde, is presently being

sated

with respect to its potential as a NERP and a proposal will

be submitted to DOE during this fiscal year. The area

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includes research and living facilities located at

the El Verde Field Station and the surrounding tracts

of tropical rain forest, already used by visiting

scientists:

+ staff and university participants

long history of ecological research, @ large data base

exists for the El Verde Site, Continued research concerned with indications of the impact of energy related activities on tropical ecosystems should be facilitated by this data base, Although located within the boundaries of the Luquillo Experimental Forest operated by U.S.D.A. Forest Service, the field station and surrounding 160 acres has been used as a base for ecological

research for an extended period of time by other agencies and groups such as the AEC, ERDA, DOE, UPR and other universities. Upon designation as a NERP, activities to

be initiated include continued site characterization; further investigation of nutrient and mineral cycling, in particular the fate of sulfur in the system; and studies

of the consumer trophic level, In addition data and pertinent Literature will be collected and evaluated in order to identify gaps and future research needs The Literature will be organized and a library will be established at the Field station. A total evaluation and organization of the already existing herbarium and faunal museum

is also a high priority goal. Initial funding by DOE will

provide support for the development of a research program,

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collection of baseline data (e.g., meteorological

data, water level monitor

ing), continued site characterization, site and facilities

maintenance, and preparation of a brochure to inform

the scientific community of the availability of the site

for ecological research. The site and its facilities

may be used by investigators with financial support provided

their research is concerned with the research program

under development by the NERP administration and contributes

to knowledge of the structure and function of the system

Relative to impacts of energy generation and utilization activities, Designation of both sites will permit further incersite comparison.

Cycling Transport and Mobilization

In FY-1979, aspects of energy cycling were the Principal accent of this project. In particular 25 stations vere selected at random from a gridded map of the forested section of the basin and leaf sauples were collect= ed from each station once @ month for a period of 3

berm

sn FY-1972 and 1973, Samples were dried, ground and labelled for future reference. Analyses of nutrients sodium, potassiun, magnesium and calcium were carried out on each sample, Analyses of selected trace elenents were also car~

ried out, In FY-79 oxygen bomb combustion techniques vere

used to bep in a determination of the caloric value of leaf

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aks

drop from the same 25 gtsciens, While there

a great

diversity of species contributing to tae leat drop, the
avecage caloric content of leaves in each forested section

can be related, as a base of cozy:

ison, to the average

caloric content of Tabonuce (Decrwodes

xcelisa) leaves,

?The turnover time for Tsbonuco leaf Litter has been shown previously to be about 16 months (c.f. personal comunica

tion from F. La Caro). Thus it should be possible to

Berive an approximate value for the energy transfer per year via leaf drop. This number is of great inyortance in the determination of energy limits to the population of

arthropods, soil sicro-organisms and Jeaf eating insect

primary consumers, Using data so far available at thie

time, the estimated average caloric value of leaves from ali 25 stations after single collection (5-31-72) is 4,656 cal/gr with a standard deviation of 189 cal/gm. The estimated

uncertainty in the values measured is no greater than 22,

Measurements of the average nitrogen and sulfur
content of the leaves will also be measured since cycling

of th

se elements are related to soil nutrient return and
world-wide pollution models.

Long Term Ecological Research (LER)

?The Terrestrial Ecology Division is presently in
collaboration with the U.S.D.A. Forest Service, Insti-
tute of Tropical Forestry in the preparation of a National

Science Foundation (NSF) proposal to designate the Lugui-

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Mo Experimental Forest as a site in which a Long Term
Ecological Research (LTER) program may be initiated,

NSF has recognized the need for continuous collection

of quantitative data in order that long-term changes, either natural or man-related, in biological systems may be evaluated. Changes through time at the same site and comparisons between sites or in the network are the

focus of five core research questions:

1, Pattern of primary productivity.

Population dynamics of selected populations
evaluation of population fluctuations and
their relationship to physical and climatic
variables.

Organic (biomass) accumulation and turnover

through time.

4, Inorganic (atmospheric and hydrologic)
accumulation and movements.

5+ Spatial and temporal patterns, frequency

and responses to disturbance:

Financial support will enable TED, CEER and ITP
to initiate the appropriate long-term measurements required
to evaluate these five core research areas.

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Industrial Siting

A proposal for the study of 2 potential power
facility sites was submitted to the Puerto Rico Electric
Power Authority (PREPA). Both flora and fauna on the
proposed sites will be characterized with respect to
populations, abundance and frequency and, in the case of

flora:

percent ground cover, An analysis of damage to fragile aspects of the ecosystems at the sites will also be made.

Other Progress

Limnological survey work on the Rio Espiritu Santo

River drainage basin was completed and an analysis of data

made, Preparation of some manuscripts was completed and the Limnological survey is being written at this time.

Ecological Effects

Cooling System Effects on Aquatic Ecosystems

A small water body ~ Par Pond ~ has been used for discharge of atomic reactor cooling water for more than 20 years. During that time, a large body of limnological data has been acquired, but little systematization of it has been attempted, An effort begun at Savannah River Laboratory SRL to analyze those data in the context of long term effects has been continued by the CEER Terrestrial Ecology Division in collaboration with SRL. A data

base has been assembled for the SKL computer and time

series summaries are in preparation,

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Intensive Bioses Culture

?

5 & 8 new project and 0 data have yer been

taken on bcnass cultivation effects on soils or water,

but a site for the studies has been arranged, and the studies can be carried out in association with yield per-acre experiments now underway.

Water Hyacinth Cover on Lakes

A man-made lake - Lake Carrafzo - is used as a potable water source for San Juan and several other municipalities. During dry seasons, the lake conventionally supports a lush superficial growth of water hyacinths *Eichhornia crassipes*. Growth of biota associated with the water hyacinth mat is responsible for considerable nitrogen, phosphorus and carbon turnover, effectively treating influents to the lake, 5 of

which are from municipal sewage

treatment plants

Plants harvested from Lake Carrafzo were re-

established in salt 3 foot deep pools with plastic

Liners and fed effluent from 9 secondary aerobic acti-

vated sludge treatment plant - El Conquistador plant in

the municipality of Trujillo Alto, The mean dry weight

of plants raised in this manner was 5.2% of the wet weight.

A Linear regression equation which relates wet weight to

dry weight is as follows:

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$$Y = 6.05129 + 0,3130x$$

in which Y = dry weight and X = wet weight. Wet weight

was determined after drip drying for 5 minutes, Se

significant relationship between growth rate and water

retention time was discernible, Productivity on a dry

weight basis was determined to be 108,195 Kg/Ha/day.

Resource Recovery

Water Reclamation Use culture

Clarification using water hyacinth dominated

Lagoons, can help secondary treatment plants meet ef-

Effluent requirements with respect to total suspended

solids, nitrogen and phosphorous levels. The pond system

described in 4.2.3 was used to determine water clarifi-

cation performance of water hyacinth used to create of

effluent from the El Conquistador aerobic activated sludge

plant using a nominal holdup time of 2 days. A mean 98%

reduction of total nitrogen, 25% reduction of total

phosphorus and 90% reduction in total solids was measured

over the short term. Somewhat puzzling was the ability

of the water hyacinth mat to recarbonate the water, lagoon

effluent frequently showing a dissolved oxygen content

between 100% and 200% higher than the treatment plant

effluent entering the lagoon. Equally puzzling was an

apparent increase (107%) in the 5-day biochemical oxygen

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demand after lagoon treatment, This may be related

to the chlorination of the final plant effluent. An

energy and nutrient interaction diagram for organics

associated with hyacinth lagoon treatment is shown in

Figure 1,

High Gradient Magnetic Separation

A program of water treatment using a very advanced

technology-high gradient magnetic separation- was begun

in FI-79, Primarily aimed at industrial and municipally

generated waste streams, a 3-day workshop of international

and local experts concluded that the use of seeded high

gradient magnetic filtration (HGF) could be of signifi-

cant benefit for effluent compliance problems in Puerto

Rico, A mobile laboratory was rented from Sa

Magnetics,

Inc. of Cambridge, Massachusetts, and after « brief training period, raw sewage effluent was treated during runs

of 55-300 gallons. Sewage was fresh influent to the EL Conquistador secondary aerobic activated sludge treatment plant. The plant performance was judged to be between adequate and expensive for that particular waste, Raw sewage from the plant conventionally required an alum

dose of 50 mg/l, powdered magnetite at a level of 350-

400 mg/l and settler/flocculant Hercofloc 831 at 3 mg/l.

Turbidity was routinely reduced by 90-95%, with a total,

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suspended solids removal of about 90%

ind biochemical

oxygen demand reduction between 60% and 69%, Rum mill-
lage wastes have not been treated as successfully so far.

Waste Sludge Utilization and Disposal

A proposal for detoxification of waste sludge from
secondary aerobic sewage treatment plants was submitted
to EPA Minority Institute Research Support (MIRS) Program
in May of 1979. The detoxification will be tried using
static pile thermophilic composting techniques and a
locally generated bulking agent-bagass, the cellulosic
fibre waste from sugarcane processing. The research will
be done in cooperation with the University of Puerto Rico
School of Medicine which will be responsible for micro-
biological and parasitological examination of the treated
wastes. The product will be used for perturbation ef-
fects in ecosystem structure and function studies, and for
agronomical studies of soil amendment regimes for inten-
sive biomass production.

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5 Publications, Theses and Reports

baa The following publications were accepted and/or appeared

Block, A.M. & Santos, R.G. & Clements, W.S., Bhajan
& Goldman, 1978. Survey of the Elemental Burden
Potential for Benthic Organism Uptake in the Rio
Espiritu Santo River Estuary of Northeast Puerto Rico.
Science-Ciencia 6 (1), 30.

Surface sediments collected at some 16 stations in
the Rio Espiritu Santo River Estuary were analyzed with
respect to 40 different elements using atomic emission
spectroscopy and visible estimation techniques. Most of
the estuary contained a metals distribution typical of

the estuaries probably reflecting the presence of a
5 km. salt wedge,

Canals, M., 1979, Some ecological aspects of the Biology of *Macrobrachium crenulatum* (Holebuis, 1950) Palaemonidae Decapoda in Puerto Rico including notes on its taxonomy. *Science-Ciencia* 6 (3): 130-132.

The distribution and ecological aspects of *Macrobrachium crenulatum* in P.R., are discussed. The species is more abundant at middle altitudes (200-600 m.) where it is the dominant species of the Palaemonidae. The distribution is limited to north-eastern Puerto Rico. Taxonomic variations in coloration and length of dactylus is influenced by age and

sex, Gravid female

present a peculiar coloration of the protopodites never reported for any member of the

Palaemonidae.

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5.3

Viblaui, ., 1975. 2 Jucinto de aga,
erassipes (lari. (Folms)), Promess pai
Science-Ciencia 6, 167-168.

Since its introduction in Puerco Rico, the vater
hyacinth hes gone froma floral curiosity to a nuisance
and pest in watervaye. This vork presents @ nex inage of

total utilization of the plant, A wide variety of us

are presented in this paper; sow of these are: donestic

wastewater treatment, chemical wastes treatment, compost,

ethane production, paper pulp and management in water

Theses

The following theses were finished by students working in the Division during 1979.

Corujo, I., 1979. Species Diversity and Distribution of

Fish in the Rio Espiritu Santo River Estuary. M.S.,
Biology, University of Puerto Rico, (in press).

Pelegrina, D., 1979. The Effect of Light and Salinity
on Rotation of Rhizophora mangle seedlings, H.S. Biology,
University of Puerto Rico (available),

Tirado, W, 1979, Faunal Ecology of the El Faro Reserve.

M.S. Biology, University of Puerto Rico (available).

Viera, D., 1979, Colonization of Communities on the Roots,
of *Rhizophora mangle*. ¥.5. University of Puerto Rico.

(available).

Zayas, J., 1979, The Ecology of a Coastal Lagoon. Studies
on the El Faro Reserve, M.S, University of Puerto Rico.

(available).

Report:

In 1979 a CEER voluse sumarizing the Rio Espirieu

Santo drainage basin was edited by members of the Terrestrial

Heology Division. The volue, entitled

ver Basin Energy

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and Environmental Planning, Methodologies and Instruments?

(CER No. 1-40) is available upon written request. The

Following papers by members of the Terrestrial Ecology

bivisi

yn appeared in the volume:

Block, A.NcB. ?The Hunan Waste Problem in Rural Zones of

?a/liigh Rainfall Watershed, 43-36.

18, M. Some Economic Aspects of the Fauna of the

Espiritu Santo River Estuary. 29-38,

Clements, RG. Physical and Ecological Aspects of the

Espiritu Santo Drainage Basin. 7-12.

Clements, RG. Hydrology of the Espiritu Santo River Basin. 67-76.

Holben, B.t., JA. Cols, M. Canals, FeA. Santos and RiG. Cloments, Precipitation Distribution and Rain-gage Networks in the Luquillo Mountains. 51-66,

The final report on the El Faro Reserve of the Conservation Trust which was prepared for DOE consideration of the reserve as 4 NERP site was also finished in June of 1979. The document is available and is referenced as follows:

Clenents, R.G. and R.C. Bunnell. Proposal to Establish

?s National Environmental Research Park at £1 Faro,

Fajardo, Puerto Rico,

One additional ceport concerning structure and

function of ecosystems vas completed during 1979, 1

concerns the impact of fresh water flooding on reef popul-

ations and the reference with abstract is as follow

oenaga, C. and M. Canals, 1979. RelaciGn de Mortalidad Masiva de Miliepora complanata (enidaria, hydrozoa) con alta pluviosidad y escorrentfa del Rio Faiardo fe5 Cayo Ahogado, Fajardo. Rroc. of the Sixth Sisposium of Natural Resources, Dept, of Natural Resources, Com sonvealth of Puerto Rico (in press).

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Salinities Tover than 25 ppt. and high turbi

occurred in May 29

1, 1979 in the reefs close to the mouth of the Fajardo River due to high precipitation in Fajardo and the Liguille Mountains. In Cayo Abogado these conditions were responsible for high mortalities of the hydrocoral *Millepora complanata*. After three days, colonization by algae started on the skeletons of the dead corals. Diversity Indexes Percentage of Mortality are compared between Cayo Abogado and Cayo Largo where salinities were not less than 34 PPT during the period of high precipitation,

The following reports pertaining to resource conservation were completed during 1979.

Block, A.MeB., Us Ortabasi, and M.B. Riesco. High Volume, High BOD Wastes: The Magnetic Separations Option. GEER Tech. Publ, 0-19 (available).

Ortabasi, Us, co-ordinator and A.MeB. Block, R.Cruz-Pérez, and J.H. Harland, J.A. Oberteuffer, M.B. Riesco and J.H. PI Watson. An Assessment of Magnetic Filtration: A

New Approach to Puerto Rico's Effluent Pollution Problems.

Proc. Workshop Magnetic Separations Applications in
Puerto Rico (available).

Vitlamil, J. and A.MeB, Block. CEER Sewage Management and
Research Program: Analysis and Selection of Study Site
Location.

Villani, J., R.G, Clenents, A.MCB. Block, FeA, Santos, Ps
Weil! A. Garcia and K, lao. Water Hyacinths for the
Clarification of Wastewaters and the Production of
Energy. CEER Tech, Publ. C-36.

?The following is a List of presentations and seminars

given by members of the division during FY-1979.

---Page Break---

Block, AuMeB.", U. Grrauasi and MB. Riese. High Voluse,
wlg? 20D Wastes: The Magner ic Sepa:
Tech, Cong. Assoc. Engr. of Puerto Rice, San Juan, PR.
way, 1979,

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Terrestrial Ecology Division Scientific Staff

During FY-1979, field ecologist Ronald Bunnell left the group to pursue graduate studies at University of California, Berkeley, CA; Félix Santos, Research Technician left to pursue Ph.D. studies in toxicology at the University of Tennessee; Oak Ridge Associated Universities Fellow Fred Ta caro returned to the University of California at Davis, In September of 1979 William Bhajan left the Division, Also in September, Richard C. Clements, Director of the Terrestrial Ecology Division for the past 10 years at CEER and its predecessor institution, Puerto Rico Nuclear Center (PRIC) resigned to take a position with the regulatory section of

U.S. Environmental Protection Agency

?Lecturers

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Staff addic Jude Susan Silos

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in tropical forests, Douglas P. Reagan, an ecologist/
herpetologist and Laurence J. Tilly, an ecologist, recently
of Savannah River Laboratory, as director of Environmental
Programs and acting director of Terrestrial Ecology Division.
The expertise which Tilly brings to the division is principal
in primary consumer analysis and aquatic biology.

A complete list of the scientific staff is as fol-

lows:

Laurence J. Tilly, Acting Director, Ph.D. (Ecology), State
University of Iowa, Iowa City.

Arthur M.B. Block, Scientist II, Ph.D. (Physical chemistry),

Rutgers University.

Jobnay Villomil, Seientiet I. M.S. (Biology), University
of Puerto Rico,

Susan Silander, Research Associate. M.S. (Biology),
University of Tonnes

Miguel Canela, Research Associare, B.S. (Biology). Inter
?american University, San Juan, P.R.

Other Staff Activities

Arthur MeB. Block attended the 53rd Colloid and Surface
Science Symposium, an American Chemical Society Neeting
hela June 11-13, 1979 in Rell, Missouri,

Johnny Vitlamil attended the Annual Meeting of the Aquatic
Vascular Plant Managenent Society held in July, 1979
in Chattanooga, Tennessee.

Johnny Villanil conferred with members of the Texas Dept.

of Health in Austin, Texas in July of 1979 about water
treatment strategies using water hyacinth,

Johnny Villamil conferred with NASA officials in Bay St.
Louis, Mississippi in July of 1979 about utilization
of water hyacinth for energy generation,

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