ECOLOGICAL BASELINE STUDIES

By Dave Vickers*

Five different investigators are working on various aspects of environmental studies of Merritt Island in the NASA John F. Kennedy Space Center (KSC) area. Their primary objective is to document the ecological situation in this area before the initiation of the Space Shuttle launches from KSC. A secondary objective was to make recommendations to NASA around June 1979 on specific types of data collection during the operations phase of the Space Shuttle.

TERRESTRIAL COMMUNITY ANALYSES

The first area of investigation is a terrestrial community analysis, of which Dr. Jack Stout was Principal Investigator. Two major programs of study were to describe and understand plant communities on Merritt Island and to understand the long-term variation in small mammals as indicators of changes in environmental quality. The plant community analysis was complementary with soil studies (completed) and ongoing rainfall and small mammal monitoring programs.

Plant Community Study

The six objectives of the plant community analysis were as follows.

1. To delimit approximately 30 undisturbed stands representative of 10 plant community types as reference points to interpret the upland vegetation complex of Merritt Island and vicinity

2. To develop a quantitative data base on the significant plants of the stands (trees, shrubs, herbs, vines, epiphytes) - Factors studied were the density (number per unit area), the frequency (spatial distribution), the basal area (cross-section area occupied by tree trunks), and the coverage (areal extent of canopy).

3. To reduce data of each stand to a statistical summary

4. To select 10 "reference" stands for continuing study from among the approximately 30 areas delimited in objective 1

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5. To establish a series of permanent line transects in the 10 designated reference stands from which to document future changes or lack of changes in the vegetation

6. To prepare a map of the existing plant communities on KSC property keyed to the master plan

Current accomplishments by Dr. Stout and his staff include the completion of a literature review; the development of sampling methods; the selection of approximately 37 sample areas around KSC, of which 29 areas have been sampled; the completion of a statistical summary of data for 10 areas around KSC; the selection of 10 reference stands; and the installation of permanent transects in each reference stand.

Expected accomplishments for the third year of the program are to complete the quantitative description of upland plant communities of Merritt Island (documentation of all 37 areas and analysis of the data), the establishment of a monitoring program based on 10 reference stands and line transects, and a map of all plant communities of Merritt Island.

Small Mammal Population Study

The second major program in which Dr. Stout was involved was the documentation of small mammal populations. The three major objectives of the small mammal population study were to monitor small mammal species in four different plant communities (flatwoods, hammock, coastal strand or coastal dune, and coastal scrub), to estimate population size of the small mammals at monthly intervals throughout the year, and to document demographic aspects of the population (survival rates, reproductive activity, sex ratios, ectoparasitic burdens, and movements).

The accomplishments to date in the small mammal population study are as follows: (1) the populations of small mammals have been monitored monthly since July 1976, (2) data are routinely entered into a computer file and reduced into summary form at 3-month intervals, and (3) an extensive literature review is in progress to expedite interpretation and publication of the results of the study.

Expected accomplishments in the next contract year are the completion of several publications describing the population dynamics of small mammals of Merritt Island over a 3-year period and the submission of a recommended monitoring program that employs existing study areas to gather baseline data for detecting changes in environmental quality.

Rainfall Study

Florida Technological University (FTU) is supplying technical expertise and manpower for the analysis of rainwater. The objectives of the rainwater

analysis are to monitor the acidity and the concentrations of sodium, potassium, calcium, magnesium, ammonium, sulfate, chloride, nitrate, orthophosphate, fluoride, vanadium, and aluminum.

Rain is collected in two buckets that have movable lids. When a detector plate becomes wet, signaling rain, a current flows and triggers the mechanism that opens the lid to permit collection of rainwater. The water is later brought inside, and the conductivity is measured to determine the total ionic contents. Other parameters, such as the pH factor, are also measured in the laboratory. When the measurements are done, the total acidity of rainfall is determined. The total acidity of the components of rainfall is then separated into weak and strong acids. In addition to total acidity, total ion content in the conductivity measurement and the overall chemical content of water are determined, particularly in relation to acidity.

The computer used for data analysis has three capabilities: data for 18 measurements, evaluative functions, and plotting. Figure 1 is a map of the present sites on Merritt Island for rainfall collection. Collections are made throughout the island. Presently, there are 18 rainfall collectors on the island located in proximity to the study sites wherever possible.

A summary of the results of the precipitation analysis program are as follows.

Dates	No. of samples	Type of study
June 23 to December 28, 1977	278	Spatial variability
November 23 to December 16, 1977	72	Sampling variability
January 1 to February 28, 1978	105	Spatial variability

Six evaluative functions are built into the computer program for handling and analyzing the data on anions and cations.

1. Ratio

2. Neutralizing component

3. Predictive pH

4. Predictive conductivity

5. Sea salt

6. Amount of nitrate contamination

The computer can also generate four types of data dealing with acid characterization of rainfall.

1. Free acidity due to volatile acids

2. Free acidity due to strong acids

3. Free acidity due to dissociated nonvolatile weak acids

4. Acidity due to undissociated weak acids

All the data are then plotted by computer to diminish the amount of manual data handling. The plots generated by the computer are exemplified in figures 2 and 3. Conclusions to date are as follows.

1. The pH of naturally occurring rainfall was quite variable (fig. 2).

2. The amount of free acid showed greater variation than the pH and reflects volume and acidity of sample (fig. 3).

3. Sampling variability of all species ranged from 5 to 20 percent (fig. 4).

Future objectives for the rainfall study include the following.

1. Continued operation of present precipitation network

2. Expansion to 18 different sites

3. Continued improvement in quality of data

4. Routine analysis of rainfall to determine amount of aluminum and vanadium

5. Repetition of sampling variability study during convectional storm activity

6. Expanded utilization of BEST computer (instrument interface and more convenient access to data)

ICHTHYOLOGICAL ANALYSES

The second major area of investigation is the ichthyological analysis, consisting of two studies.

1. Lagoonal fish study (ecological investigations of the marine fishes found in the brackish lagoons around KSC)

2. Molly reproduction study (detailed analysis of reproductive performance in the sailfin molly as an "indicator" for environmental monitoring)

Lagoonal Fish Study

The overall objective of the lagoonal fish study is to understand the basic nature and ecology of the fish fauna in the Indian River lagoon system around KSC. This study complements earlier NASA-supported research

on the fishes in fresh and brackish waters of Merritt Island. Together, these two studies will provide the only comprehensive knowledge available on the fishes of the KSC area.

Component objectives include the following.

1.   Inventory the fish species inhabiting the open, brackish waters in the Indian River lagoonal system surrounding Merritt Island and KSC.

2.   Monitor the relative abundance of selected fish species at seven permanent study sites in the lagoonal waters by means of a trawling program.

3.   Evaluate changes in selected physiochemical parameters of the water in order to evaluate their influence on fish distribution and abundance.

4.   Monitor the commercial catch of mullet and sea trout in the lagoonal waters around Merritt Island to evaluate the status and dynamics of the fishery.

Accomplishments to date are as follows.

1.   108 fish species have been documented; habitat, distributional, and other natural history data are available.

2.   Bimonthly trawl sampling has occurred at seven permanent study stations since November 1976. Data were stored and analyzed for frequency, biomass, life history, stage composition, importance ranking, and species diversity.

3.   Bimonthly analyses of water chemistry at seven permanent study stations were completed. Other data on water parameters from observations throughout the lagoonal system were obtained. Data were stored and analyzed.

4.   More than 1700 records of daily catch were gathered from consulting commercial fishermen. Data were stored and computer-analyzed, and graphs of the monthly catch-per-unit-effort were prepared.

5.   Ancillary studies (such as cold-caused fish mortality and stingray biology) were conducted.

Third-year projected accomplishments are as follows.

1.   To continue faunal analysis, with emphasis on poorly sampled areas and new collecting methods, and to write an annotated faunal list

2.   To continue trawl sampling, to refine data analysis, and to subject results to numerical community classification procedures

3.   To continue bimonthly and unscheduled water chemistry analyses and to test for correlations between water parameters and fish population characteristics

4. To continue to collect and analyze data from commercial catch censuses and to establish annual trends in catch patterns from graphic analysis

5. To publish the results in scientific journals

Molly Reproduction Study

The overall objective of the molly reproduction study is to understand the details of molly reproduction so that reproductive performance can be used to evaluate subtle changes in environmental quality. Component objectives are as follows.

1. To determine the fecundity, fertility, and size of reproducing females from monthly samples at two study sites

2. To relate reproductive performance to physical, chemical, and biological environmental parameters suspected to be important determinants of reproductive fitness

3. To conduct limited laboratory investigations designed to answer specific questions about molly reproduction

Accomplishments to date include the following.

1. Analysis of reproduction from samples taken monthly since October 1976 at three permanent study sites, computerization and analysis of results, and computation of appropriate descriptive statistics

2. Monthly analysis of water chemistry parameters at three molly reproduction study sites and computerization and analysis of results

3. Design and execution of laboratory experiments on sex ratio, gestation period, growth rates, and food-fecundity relationship

Third-year projected accomplishments are as follows.

1. To continue monthly analyses of field reproduction until December 1978

2. To continue monthly water chemistry analyses until December 1978

3. To refine data analyses and graphic presentations

4. To design and execute appropriate supporting laboratory experiments

5. To publish results in scientific journals

THREATENED AND ENDANGERED SPECIES OF KSC

The third major area of investigation is the study of threatened and endangered species of KSC. Dr. L. M. Ehrhart is Principal Investigator. The number of threatened and endangered species at KSC is relatively large. These programs are aimed at providing KSC with consultation, awareness, and evaluation of matters relating to the Endangered Species Act of 1973.

Bird Studies

Endangered and threatened bird species were studied by means of weekly ground surveys and occasional light aircraft surveys. The American wood stork and the dusky seaside sparrow have been the primary objectives of endangered species surveys. Brown pelicans, southern bald eagles, ospreys, least terns, and the scrub jay were included in the threatened species surveys. Rare species and species of special concern were also included in the surveys.

Marine Turtle Studies

Although the marine turtle is not an endangered species, the KSC beaches are a major nesting ground for the marine turtle; therefore, an extensive study of their population, nesting habits, fertility rates, and hatchling size and vigor has been conducted. The objectives of the marine turtle studies were as follows.

1. To develop an accurate estimate of the size of the population (and its variation from year to year) of adult female marine turtles nesting on KSC beaches (figs. 5 and 6)

2. To develop a thorough understanding of the species composition of the nesting population

3. To develop an understanding of the migratory patterns of sea turtles nesting at KSC

4. To develop an understanding of fertility rates and the normal variation of sea turtle egg clutches at KSC

5. To develop an understanding of developmental rates and hatchling size and vigor at KSC

6. To cooperate with the staff of the Merritt Island National Wildlife Refuge in efforts to propagate sea turtles at KSC

7. To determine the size and species composition of the sea turtle population in the lagoonal waters surrounding KSC

8. To determine the age structure (as estimated by size) of the estuarine turtle population

18 at FTU

SITE NO.	DATE
01	7-20-77
02	4-10-78
05	3-8-78
06	3-8-78
08	5-25-78
10	3-8-78
11	7-20-77
12	7-20-77
13	8-10-77
14	11-18-77
16	3-8-78
18	6-22-77
19	7-20-77
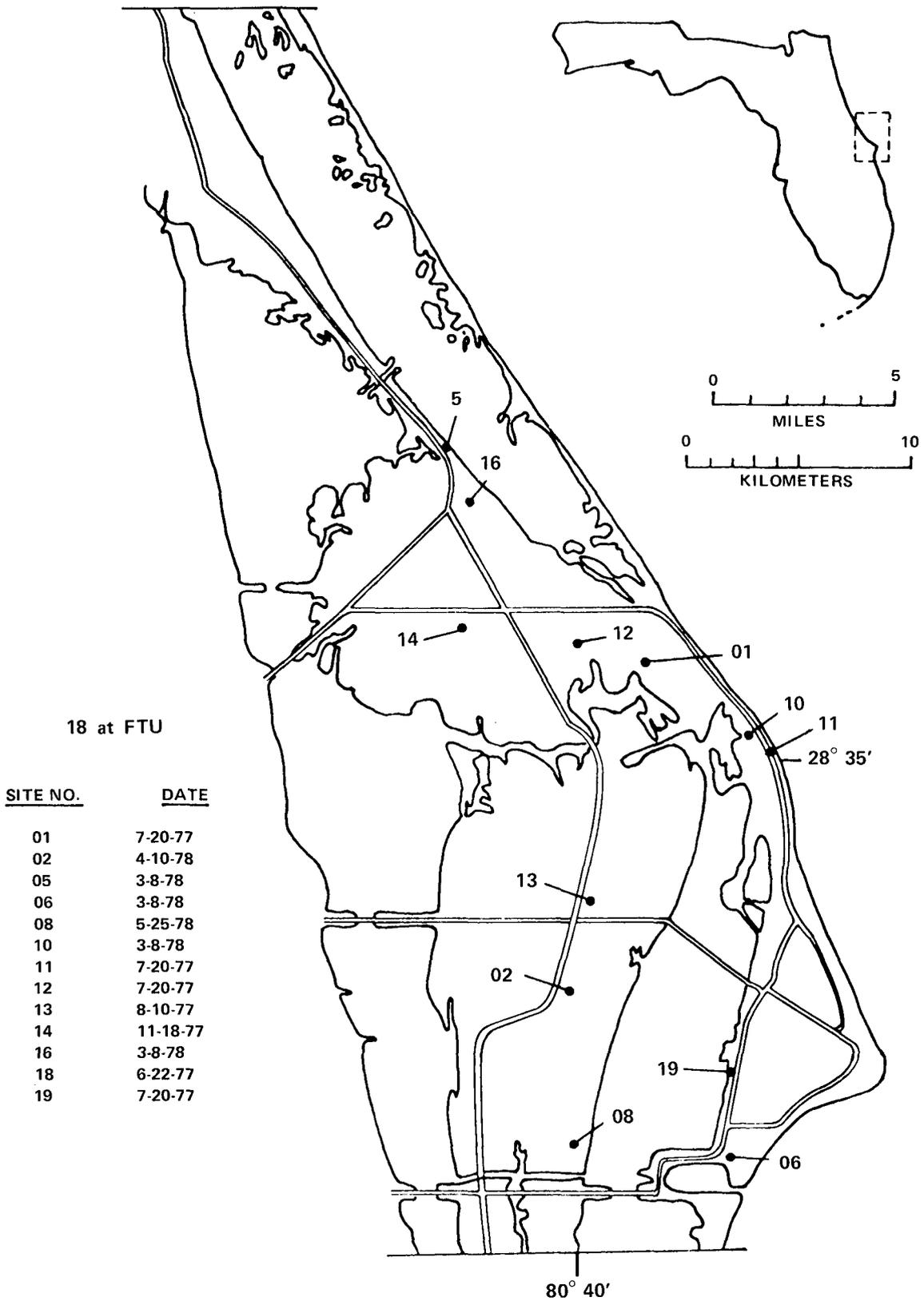
Figure 1.- Location of currently operational precipitation collectors.

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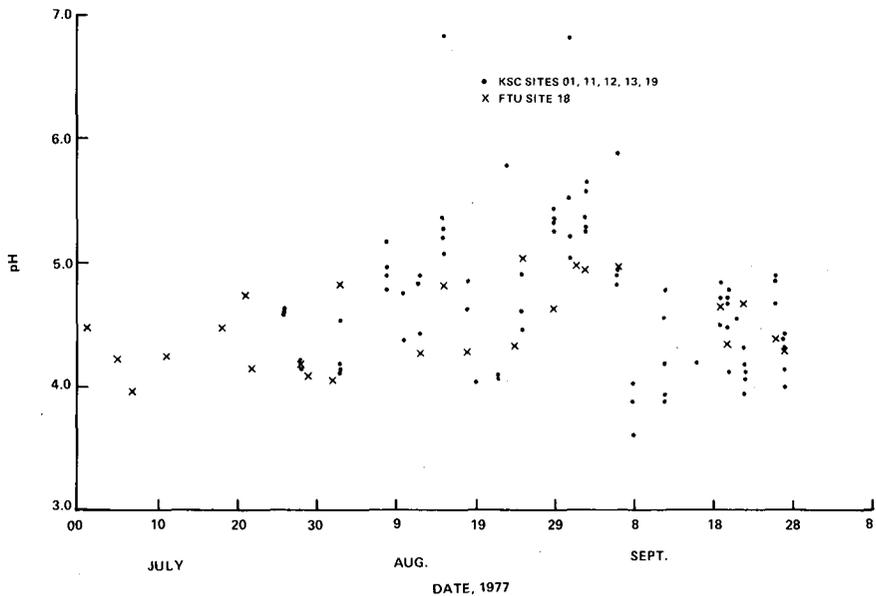
(a) July to September 1977.
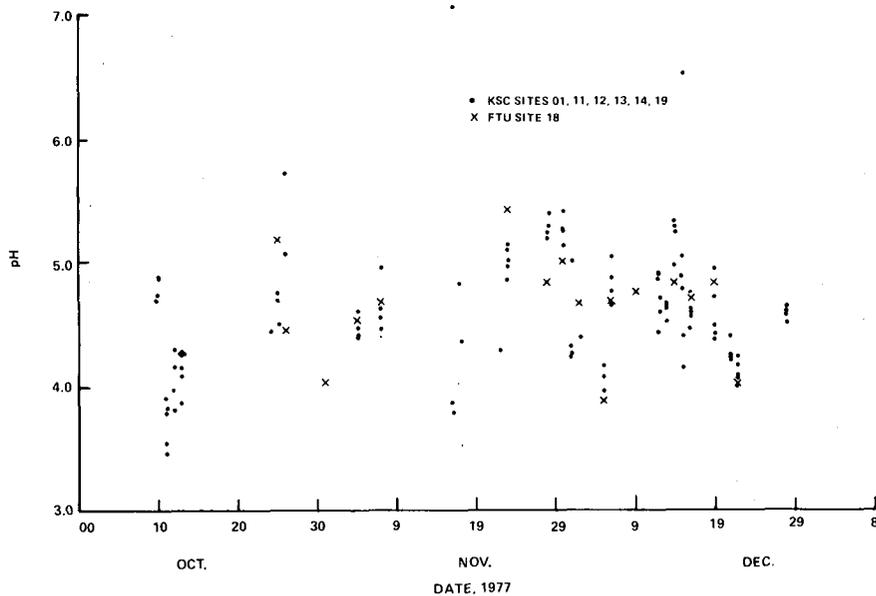
(b) October to December 1977.

Figure 2.- East-central Florida rainfall precipitation pH variation.
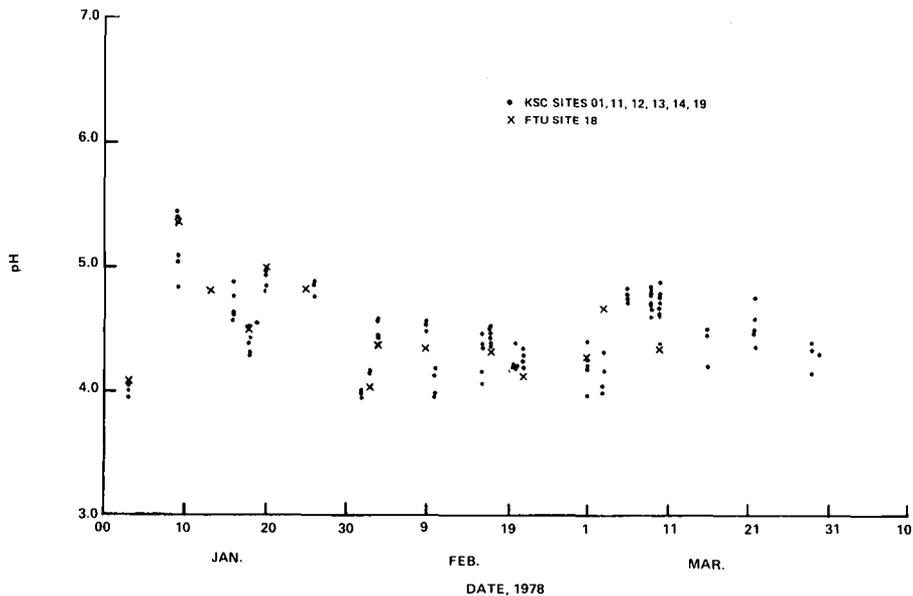
(c) January to March 1978.

Figure 2.- Concluded.
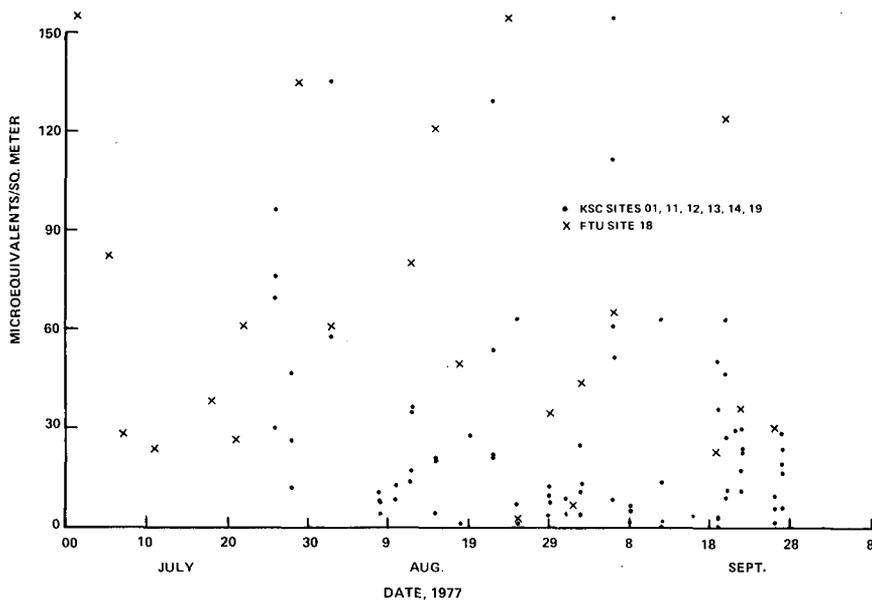
(a) July to September 1977.

Figure 3.- Variation of total free acidity in east-central Florida rainfall
precipitation. Free acidity and volume of samples are used to determine
the total.
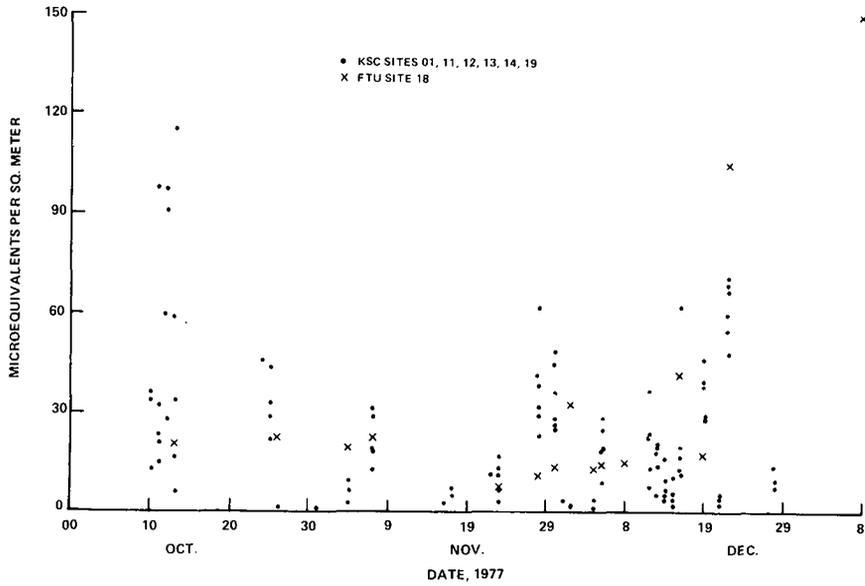
(b)   October to December 1977.
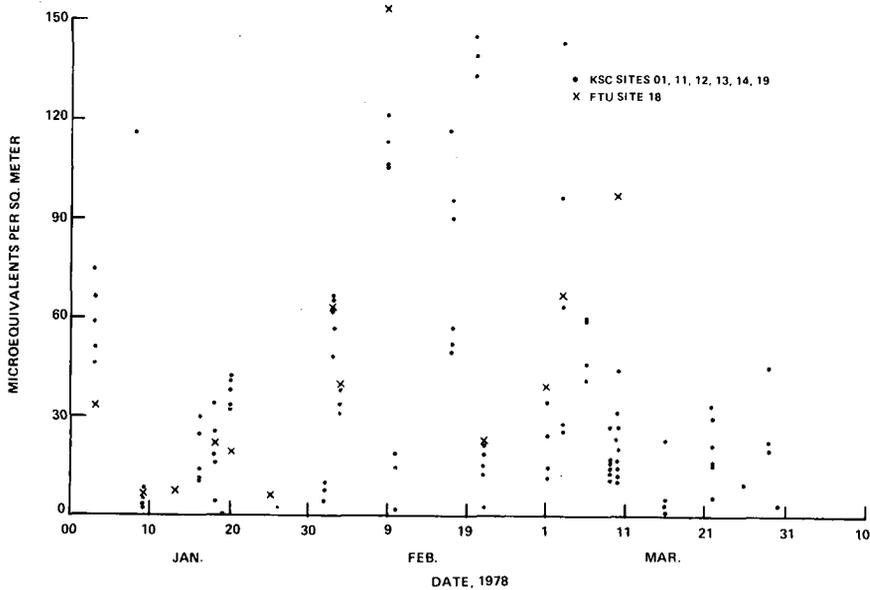

(c)   January to March 1978.

Figure 3.- Concluded.

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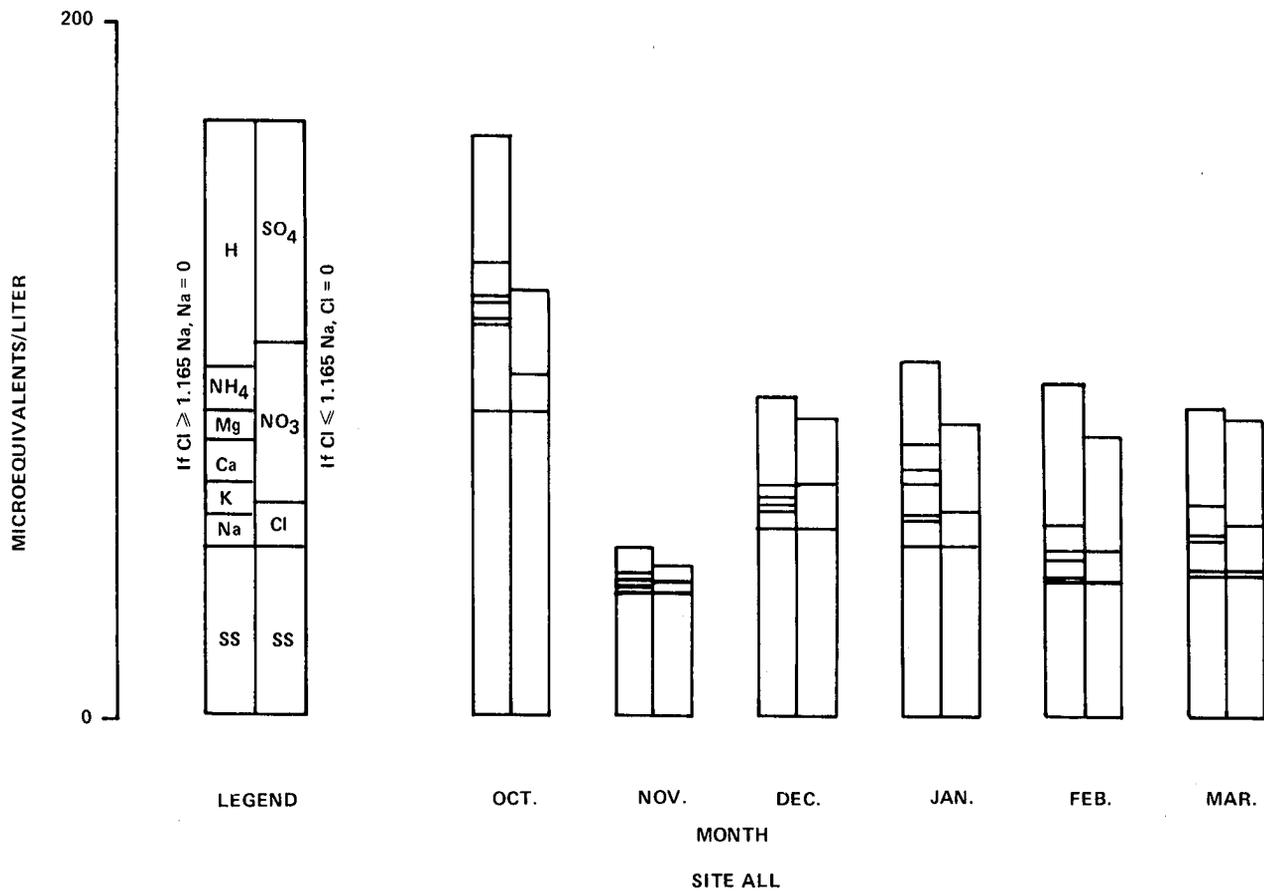
Figure 4.– Variation of monthly volume-weighted average composition of east-central Florida precipitation (all samples).
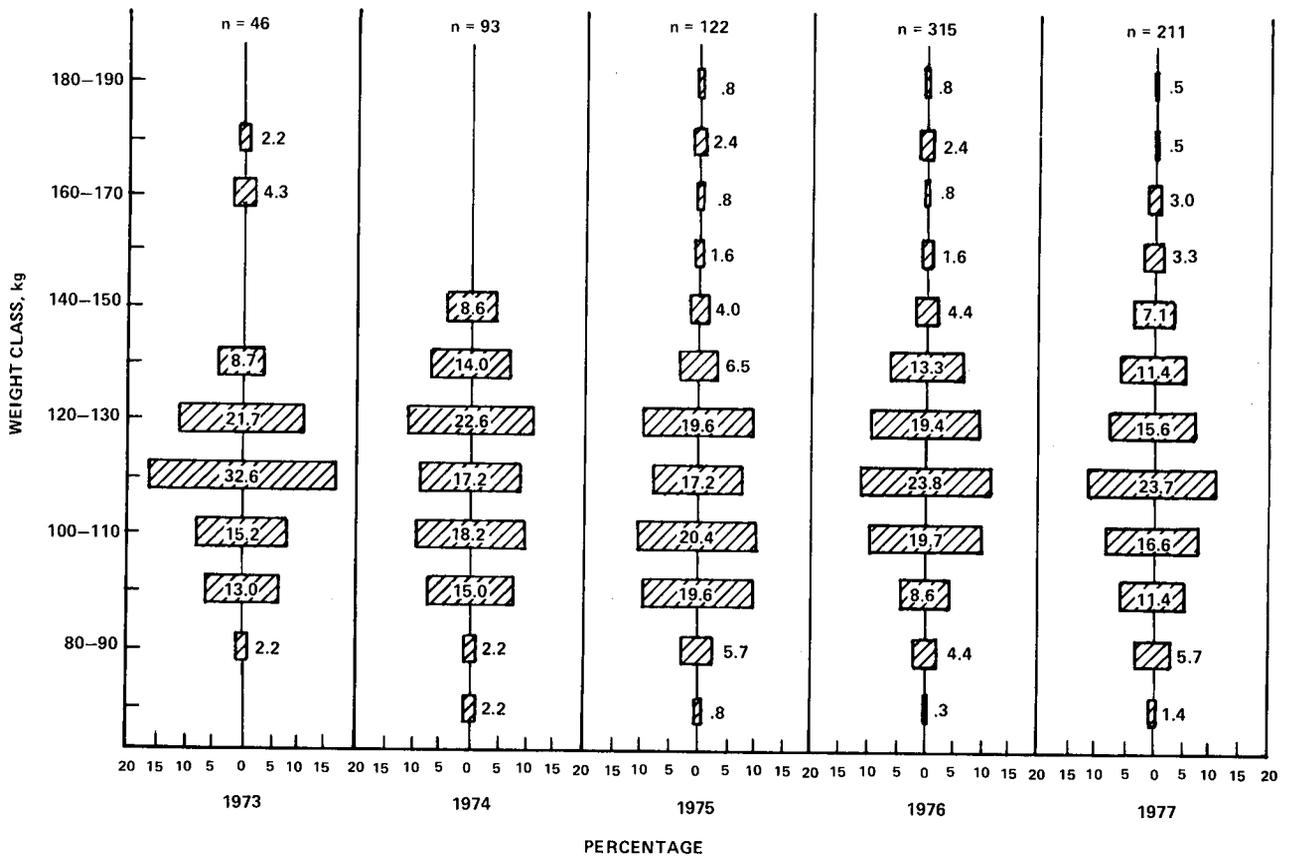
Figure 5.- Weight and class distributions of the populations of female loggerhead turtles nesting at KSC (1973 to 1977).

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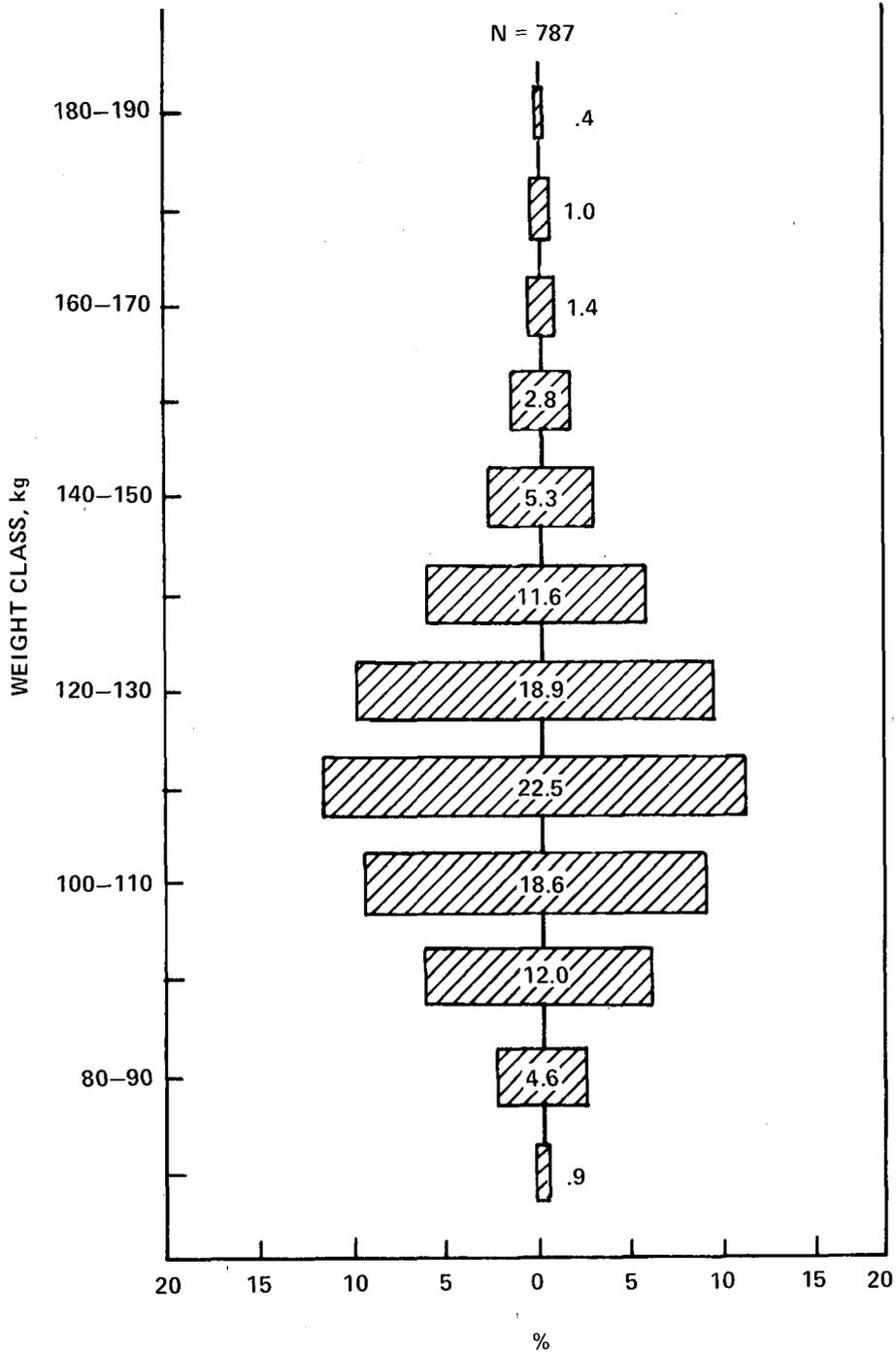
Figure 6.- Five-year mean weight and class distribution of the populations of female loggerhead turtles nesting at KSC (1973 to 1977).