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ABSTRACT

This teaching guide deals with the ecological composition of a marsh and the ecological effects certain changes might have on a marsh. This study focuses on the fresh water marsh found in the Florida Everglades which can furnish the student with several examples of past, present, and possible future ecological changes which impact this ecosystem. The study is developed around eight basic inquiry questions about change in the ecosystem of a marsh, which are accompanied by a series of learning activities. No one activity will answer all of the questions; however, completion of all investigations should provide the student with sufficient data on which he can develop tentative conclusions. The student learning activities have been designed into a role-playing simulation entitled "The Everglades Survival Game." The guide is divided into three sections. The inquiry questions, section one, outlines the activities for the simulation game and includes learning activities, resources, evaluation, and teacher suggestions. The student materials, section two, are statements, background information or activities which are used in the game. The teacher comments, section three, introduces role playing, and provides an overview of the game, game roles, game rules, and materials needed for the game. (TK)

# MAN'S IMPACT ON THE ENVIRONMENT

## The Freshwater Marsh as an Ecosystem





FOR PILOT TESTING ONLY

# The Freshwater Marsh as an Ecosystem

# MAN'S IMPACT ON THE ENVIRONMENT

## Inquiry Questions for Investigating Change in an Ecosystem

I. What is a definition of the ecosystem being investigated?

II. What are some of the biotic and abiotic features of the ecosystem and how do these features interrelate?

III. Where are some specific locations of the ecosystem being investigated?

IV. What biotic and abiotic features in the ecosystem have changed and are undergoing change?

V. What are the natural factors causing change in the ecosystem and how have they been brought about?

VI. What are the man-made factors causing change in the ecosystem and how have they been brought about?

VII. What are the results of the changes?

- A. Beneficial?
- B. Detrimental?

VIII. What, if any, new changes are needed in the ecosystem?

IX. How might these needed changed to the ecosystem be brought about?

# PURPOSE AND ORGANIZATION FOR THE STUDY OF FRESH WATER MARSH IN THE FLORIDA EVERGLADES

In order for students to understand the ecological composition of a marsh and ecological effect certain changes might have on a marsh, it is necessary to delineate some example for them to study. The fresh water marsh found in the Florida Everglades can furnish the student with several examples of past, present, and possible future ecological changes which impact this ecosystem. A great deal of public attention has been focused on the Everglades marsh as a result of the national park which is located in the area, and recent attempts to build a jetport there. Because of this attention, the student may be exposed to all of the various arguments concerning change in the natural environment of a marsh area in order to meet the various needs of a growing population.

The student will study the Everglades by participating in a series of learning activities which hopefully will lead him to intelligent answers to eight basic inquiry questions about change in the ecosystem of a marsh. No one activity will answer all of the questions, however, completion of all the investigations (a set of activities) should provide the student with sufficient data on which he can base legitimate conclusions to these inquiries. The student learning activities have been designed into a role-playing simulation entitled The Everglades Survival Game. Read carefully Teacher Comment No. 1, page 118, for a thorough explanation of this simulation.

The majority of investigations in The Everglades Survival Game will be carried out in Learning Center. Teacher Comment No. 2, page 129, gives a rationale and description of Learning Centers. Six Learning Centers, one for each of the Investigations, numbers three through eight, need to be created for this simulation. All activities and resources required at each Center are provided in this package. The materials should be available for student use throughout the entire Everglades Survival Game, however, the teacher may wish to set a time limit for the activities performed at the respective Learning Centers.

Inquiry Question:

I. WHAT IS A DEFINITION OF THE ECOSYSTEM BEING INVESTIGATED? (FRESHWATER MARSH)

| Learning Activities | Resources | Evaluation | Teacher Suggestions |
|---|---|---|---|
| Investigation #1: | | | |
| A. VIEW SLIDES<br>Show students the set of marsh slides. | A. VIEW SLIDES<br>Slides 1-20, p. 114. | A. VIEW SLIDES | A. VIEW SLIDES<br>Pose Inquiry Question to students and have them consider it as they watch the slides. |
| B. DISCUSS/LIST<br>1. Divide class into small groups.<br>2. Have each group discuss the slides and make a list of:<br>a) physical characteristics of a marsh, and<br>b) plants and animals found in the marsh.<br>3. One list (parts a and b) from each group will be submitted for evaluation. | B. DISCUSS/LIST | B. DISCUSS/LIST<br>Award 10 ESPs for each correct item on part A and part B of the list. Multiply the total by the number of students in the group and allow the group leader to distribute the points on the basis of individual participation in the group. | B. DISCUSS/LIST<br>1. The evaluation system suggested will motivate greater participation in group discussion and cooperation. If a student feels he has been unjustly rewarded, he may appeal to you and the group leader must justify his distribution of points.<br>2. Read TC #3, p. 133, (Life in a Marsh). |
| C. DEFINE/REPORT<br>1. Using their lists as guides, each group will compose a definition of a marsh.<br>2. Each group's definition is reported by being placed on the chalkboard. | C. DEFINE/REPORT | C. DEFINE/REPORT<br>Award each group 10 ESPs multiplied by the number of students in the group, if they submit a definition. Group leader will distribute points. | C. DEFINE/REPORT |
| D. DISCUSS<br>Have class discuss each definition and arrive at a composite of the best suggestions. | D. DISCUSS | D. DISCUSS<br>If the class accepts any element of a group definition, each member of that group | D. DISCUSS |

Inquiry Question:

I. WHAT IS A DEFINITION OF THE ECOSYSTEM BEING INVESTIGATED? (FRESHWATER MARSH)

| Learning Activities | Resources | Evaluation | Teacher Suggestions |
|---|---|---|---|
| | | is given 10 ESPs. | |
| E. READ/COMPARE<br>Have each student read SC #1 and compare it with the class's composite definition. Make changes if needed. | E. READ/COMPARE<br>SC #1, p. 29, (definition of a marsh) | E. READ/COMPARE | E. READ/COMPARE |

**Inquiry Question:** II. What are some of the biotic and abiotic features of the ecosystem and how do these features interrelate?

| Learning Activities | Resources | Evaluation | Teacher Suggestions |
|---|---|---|---|
| Investigation #1:<br>(Plan a Field Trip)<br><br>A. CONDUCT PRE-FIELD ACTIVITIES<br>1. Arrange site visitation<br>2. Divide class into the following inspection teams:<br>a. One general inspection team<br>1) 4-5 members<br>2) Read SC #32for duties<br>b. Specific inspection teams for remainder of class<br>1) 4-5 members<br>2) Read SC#33for duties and data requested.<br>3. Construct a materials kit for each team.<br>a. Collect necessary equipment.<br>1) Specific inspection team (SC#34, Part I)<br>2) General inspection team (SC#34, Part II)<br>b. Make a checklist for each kit.<br>c. Locate a collection box for each team. | A. CONDUCT PRE-FIELD ACTIVITIES<br>SC#32, page 83, (Duties . . . )<br>SC#33, page 84, (Duties . . . Data sheet)<br><br>SC# 34, page 89. | A. CONDUCT PRE-FIELD ACTIVITIES | A. CONDUCT PRE-FIELD ACTIVITIES<br>1. Brevard County teachers should contact the following source and specify type of ecosystem (fresh water marsh) they wish to visit:<br>Robin Fields<br>Merritt Island National Wildlife Refuge<br>P. O. Box 6504<br>Titusville, Fla. 32780<br>2. Investigation # 1 is designed to acquaint students with the biotic (living) and abiotic (non-living) factors of an ecosystem. Interrelationships can be shown best after two ecosystems have been investigated.<br>3. The procedures laid out for the investigation will be applied to other ecosystems studied. |

**Inquiry Question:** II. What are some of the biotic and abiotic features of the ecosystem and how do these features interrelate?

| Learning Activities | Resources | Evaluation | Teacher Suggestions |
|---|---|---|---|
| 4. Conduct a "dry run" of each study to be performed.<br>a. Review SC #'s35, 36, 37, 38, 39, 40, 41, 42 and conduct tests.<br>b. Have students enter results on data sheets (SC# 33).<br>c. Study SC# 43 for counting and collecting procedures. | SC#'s 35-43, pp. 90-111.<br>SC# 33, p. 84.<br>CS# 43, p. 111. | | 4. It is necessary that each student have a working knowledge of all techniques and equipment needed for collecting the data required in SC# 33. Most of these procedures are explained in the Student Comments #'s 35-42, and need to be reviewed by the teacher. These analyses can either be explained through demonstration or as inquiry oriented investigations run concurrently with the ecosystem study. |
| B. EXECUTE IN-FIELD ACTIVITIES | B. EXECUTE IN-FIELD ACTIVITIES | B. EXECUTE IN-FIELD ACTIVITIES | B. EXECUTE IN-FIELD ACTIVITIES |
| 1. Have students observe general site for five minutes before staking out a specific site.<br>2. Then have them note or sketch all that is observed.<br>3. Have specific inspection teams select and stake out site and conduct studies required in SC# 33. | SC# 33, p. 84. | | 1. Stress to students to watch for variety and differences.<br>2. To increase enthusiasm, the general inspection team may make a movie of the field trip. A great number of creative ideas can be developed around this media.<br>3. Encourage teams to scatter out their sites in order to obtain a variety of areas seen. Impress the need for accurate reporting. |

Inquiry Question: II. What are some of the biotic and abiotic features of the ecosystem and how do these features interrelate?

| Learning Activities | Resources | Evaluation | Teacher Suggestions |
|---|---|---|---|
| C. PERFORM POST-FIELD ACTIVITIES<br><br>1. Have teams review procedures from Activity A-4 and complete necessary lab work.<br>2. Record results on Data Sheet (SC# 33) and make required written work. (SC#'s 36-42)<br>3. Have teams construct a vertical drawing of their inspection site.<br>a. See SC# 43 for directions.<br>b. Compare drawing with other groups.<br>4. Hold a class discussion to determine a general answer to the Inquiry Question.<br>a. Use Data Sheets and drawings as sources of information.<br>b. Record conclusions on chalkboard. | C. PERFORM POST-FIELD ACTIVITIES<br><br>SC# 33, p. 84.<br>SC#'s 36-42, pp. 91-107.<br>SC# 43, p. 111. | C. PERFORM POST-FIELD ACTIVITIES<br>1. Data Sheets and other written work can be collected and evaluated.<br>2. Vertical drawing can be evaluated. | C. PERFORM POST-FIELD ACTIVITIES<br><br>Review SC's 36-42, pp. 91-107 to see what lab work is required. |

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| Learning Activities | Resources | Evaluation | Teacher Suggestions |
|---|---|---|---|
| Investigation #3:<br>(Plant/Vegetation Learning Center)<br><br>A. READ/DISCUSS/WRITE<br><br>1. Divide 1/6 of class into this Center.<br>2. Have students read SC #'s 2 - 8.<br>3. Students discuss the change in vegetation zones and in a written report tell how each zone has been altered in each of these elements:<br>a) size of zones<br>b) composition of zones | A. READ/DISCUSS/WRITE<br>SC #'s 2 - 8, pp. 30-47. | A. READ/DISCUSS/WRITE<br>Collect written reports for evaluation. | A. READ/DISCUSS/WRITE<br>For each of the Investigations 3, 4, 5, 6, 7 and 8, set up a separate Learning Center. |
| B. VIEW/DRAW<br>1. Have students study SC #9 and #10.<br>2. Have each student draw two maps of vegetation zones as they appeared in 1871 and now. | B. VIEW/DRAW<br>SC #'s 9, 10, pp. 48-49, (maps of marsh: 1871 and 1971). | B. VIEW/DRAW | B. VIEW/DRAW |
| C. READ/DRAW<br>1. Have students review SC#'s 3, 5, 6 and 7.<br>2. Have students draw a map of South Florida showing the extent of the Everglades. Include in this map all the major dykes and canals of the F. C. D. | C. READ/DRAW<br>1. SC #'s 3, 5, 6, 7, pp. 32, 35-42.<br>2. SC #11, p. 50, (Florida map, 1971). | C. READ/DRAW | C. READ/DRAW<br>1. SC #'s 3, 5, 6, and 7 deal with the FCD's early philosophy to drain the swamp and make the area inhabitable for humans.<br>2. You may want the students to simply study the overlays or you may want to present them yourself. However, if the student actually draws in |

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| Learning Activities | Resources | Evaluation | Teacher Suggestions |
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| | | | the extensive canal works, he may be impressed by the sheer volume of water that must be flowing from the glades into the sea.<br>3. The increasing population, of course, has brought about the need to drain the marsh to prevent seasonal flooding. This outpouring of fresh water has been severely criticized as not only a waste of fresh water but as being responsible for the drying of the marshlands. |
| D. WRITE/PRESENT<br>1. Students compose a conversation between a pine tree, a cypress tree and a red mangrove, showing "Their Changing Territory."<br>2. Students will present the conversation to the class. | D. WRITE/PRESENT | D. WRITE/PRESENT<br>Evaluate written conversation for depth of thought thoroughness and practicality. | D. WRITE/PRESENT<br>1. Students at this Center should keep a copy of their conversation for the Show and Tell activity (Investigation #9, p. 25 ) to be held later.<br>2. Concluding activities at each Learning Center will be presented later to the entire class. |

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| Learning Activities | Resources | Evaluation | Teacher Suggestions |
|---|---|---|---|
| Investigation #4:<br>(Muck Farming Learning Center) | | | |
| A. GRAPH/WRITE<br>1. Divide 1/6 of students into this Center.<br>2. Have students study SC #12 and then prepare a line graph of average rainfall in the Everglades.<br>3. Study the graphs and write out an explanation to the following question: "Has the rainfall changed significantly to cause 'the dehydration death of the Everglades'?" | A. GRAPH/WRITE<br>SC #12, p. 51, (Rainfall Factors for South Florida). | A. GRAPH/WRITE | A. GRAPH/WRITE<br>A relatively level line would indicate no drastic change in rainfall since 1940. A decreasing slope in line would indicate a decrease in rainfall. The line actually fluctuates from high peaks to low. The trend seems to be stable. There is no real decrease in the overall slope even if a straight line was drawn to represent the average line. Have the students try it. Decreasing rainfall is not the answer. |
| B. READ/DISCUSS<br>1. Students read SC #'s 2 - 8.<br>2. Students discuss the reasons for the statement, "We are losing our Muck." | B. READ/DISCUSS<br>See SC #'s 2 - 8, pp. 30-47. | B. READ/DISCUSS | B. READ/DISCUSS |
| C. REPORT<br>Encourage group to decide on a written composite report to the above statement. | C. REPORT | C. REPORT<br>Chairman records their reasons and submits for evaluation. | C. REPORT |

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| Learning Activities | Resources | Evaluation | Teacher Suggestions |
|---|---|---|---|
| D. CREATE/PRESENT<br><br>1. From the above report, have students create a TV presentation: "We are losing our Muck."<br>2. Make a written script for the TV presentation which includes roles for each group member and is submitted for evaluation.<br>3. TV presentation will be made to entire class later. | D. CREATE/ PRESENT | D. CREATE/PRESENT<br><br>Evaluate the written presentation. | D. CREATE/PRESENT<br><br>1. Suggest to students that their TV presentation may cover the following ideas:<br>- What are muck farmers?<br>- How do they affect the Everglades?<br>- Were the effects beneficial and/or detrimental?<br>2. Encourage students to give their suggestions |

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| Learning Activities | Resources | Evaluation | Teacher Suggestions |
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| Investigation #5:<br>(Water Learning Center)<br><br>A. GRAPH<br>1. Divide 1/6 of class into this Center.<br>2. Have students review SC #13 and then make a line or bar graph depicting the water use data. | A. GRAPH<br>SC #13, p. 52.<br>(Water Use in South Florida). | A. GRAPH | A. GRAPH<br>1. Water shortages are becoming acute in South Florida. Some scientists estimate only 10 years until the area will face severe water shortage in the winter months. As the population increases so does the water demand.<br>2. As more water is used in South Florida, the water table drops. The primary source of replenishment has been rainfall, particularly in the Everglades. But as the Everglades dry up, the water table there drops also. This allows salt water from the ocean to seep into what was before fresh water limestone "aquifers." Wells that once produced fresh potable water, now produce undrinkable levels of salt water.<br>3. TC #6, p. 138 , gives background to the water control problem. |

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| Learning Activities | Resources | Evaluation | Teacher Suggestions |
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| B. READ<br>Have students read SC #14 and answer the following question:<br>- How do you explain the movement of salt water inland? | B. READ<br>SC # 14, p. 53, (Water Control in Southern Florida). | B. READ | B. READ |
| C. WRITE<br>Using the data from activities A and B above, have student make a written analysis of the following statement:<br>As more fresh water is drawn from the underground water supply in Southern Florida, the original source of replenishment, the Everglades Marsh, cannot maintain levels high enough to prevent salt intrusion from creeping into the fresh water sources on the coast. | C. WRITE | C. WRITE<br>Collect written work and evaluate. | C. WRITE |
| D. ANALYZE DATA<br>1. Have students study SC #s 16, 17, 18, and 19 and construct a chart on water for the years 1963 and 1967 which includes the following data:<br>a) total rainfall in Everglades for each year,<br>b) water discharge into the Everglades for each year, and | D. ANALYZE DATA<br>1. SC #'s 16, 17, 18 and 19, pp. 56-59, (water control data). | D. ANALYZE DATA<br>1. Collect chart and evaluate contents.<br>2. Collect written report and evaluate. | D. ANALYZE DATA<br>1. These gates and gauges are located in the northern section of the Everglades. They are responsible for controlling and measuring the water released into the Everglades. Note that the flow of water is from north to south. |

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| c) gauge (water) height – in lowest and highest readings – in the Everglades for each year.<br>The charts may look like SC # 20.<br>2. Having completed their chart, students will analyze the data by noting answers to the following inquiries:<br>- How does rainfall compare for the two years?<br>- How does water discharge compare for the two years?<br>- How does gauge (water) discharge compare for the two years?<br>Is rainfall responsible?<br>What is responsible for the differences?<br>3. In a written summary report, have students answer these questions:<br>- How does water discharge by the FCD affect water levels in the Everglades? Is this good or bad?<br>- If the FCD continues the policy of water discharge as exemplified in 1963, what do you predict will be the effect | SC #20, p. 60, (Water Control Data Chart). | | 2. TC # 4, p. 134, shows data that students should have selected from SC #'s 16, 17, 18 and 19.<br>3. Students who wish to conduct an indepth study of the water control measures may get in touch with the following:<br>Central and Southern Fla. Flood Control District<br>P. O. Box V<br>West Palm Beach<br>Florida 33402 |

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| on the Everglades environment?<br>- What should be the FCD's policy on waste discharge? | | | |
| E. READ/LIST<br>1. Have students read SC #'s 2-8.<br>2. Have students decide how each of the following would react to the readings:<br>- a biologist<br>- a conservationist<br>- a FCD member<br>- an engineer<br>3. List reactions for each viewpoint represented. | E. READ/LIST<br>SC #'s 2-8, pp. 30-47. | E. READ/LIST | E. READ/LIST |
| F. PLAN/PRESENT<br>1. Have students plan a "rap session", in which the four viewpoints (Activity E) are argued.<br>2. "Rap session" will be presented to the entire class later. | F. PLAN/PRESENT | F. PLAN/PRESENT | F. PLAN/PRESENT |

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| Learning Activities | Resources | Evaluation | Teacher Suggestions |
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| Investigation #6:<br>(Wildlife Learning Center) | | | |
| A. DISCUSS<br>1. Divide 1/6 of class into this Center.<br>2. Have students discuss the following questions:<br>- What is an endangered species?<br>- What is the value of having an endangered species list? | A. DISCUSS<br>President of Indian River Audubon Society: Harold E. Wyle, telephone 632-5855. Mr. Wyle may be able to help answer these questions. | A. DISCUSS<br>Award ESPs (5-10) to students who offer valid answers and reasons. | A. DISCUSS |
| B. VIEW/DISCUSS<br>1. Present to students two movies:<br>a) "Flight into Oblivion"<br>b) "Alligator"<br>2. Have group discuss the following:<br>a) What role does the alligator play in preserving the Everglades?<br>b) What value to the Glades is there in preserving large areas in which the alligator can roam in a wild state?<br>c) What are the advantages and disadvantages to a species that specializes in a limited food preference?<br>d) What is the value to the | B. VIEW/DISCUSS<br>Movies may be borrowed, free of charge, from the following:<br>Central and Southern Flood Control Dist.<br>P. O. Box 1671<br>West Palm Beach<br>Florida 33402 | B. VIEW/DISCUSS<br>Award 15 to 20 ESPs per answer per person in the group. Group leader will distribute points on basis of individual performance in the group's effort to answer the questions. | B. VIEW/DISCUSS |

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| Everglades kite of preserving large areas of the 'glades for that species? | | | |
| C. REVIEW/LIST/DISCUSS<br><br>1. Review SC #21, a list of endangered species of the U. S.<br>2. Review SC #22, a list of animals of the Everglades.<br>3. List, by comparing the two, all species of the Everglades that are rare and endangered or nearly so.<br>4. Discuss the advantages and disadvantages of preserving the Everglades for the benefit of these species. | C. REVIEW/LIST/DISCUSS<br>SC #'s 21, 22, pp. 61-62. | C. REVIEW/LIST/DISCUSS<br>Award 5 ESP's for each species correctly identified and listed. | C. REVIEW/LIST/DISCUSS<br><br>Further work may be initiated by students interested in pursuing the habits of some of these species. |
| D. READ/REACT<br>1. Have students read SC #'s 2-8.<br>2. Have students react to each reading as if they were one of the following:<br>- a bald eagle<br>- a Florida panther<br>- a green turtle<br>3. Write out reactions | D. READ/REACT<br>SC #'s 2-8, pp. 30-47. | D. READ/REACT<br>Collect written reactions and evaluations | D. READ/REACT |

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| E. PLAN/PRESENT<br>1. Plan a skit in which view points of the eagle, panther and turtle are demonstrated.<br>2. Skit will be presented to class later. | E. PLAN/PRESENT | E. PLAN/PRESENT<br>Judge skits by awarding ESPs for content and presentation. | E. PLAN/PRESENT |

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| Learning Activities | Resources | Evaluation | Teacher Suggestions |
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| Investigation #7:<br>(Jetport Learning Center) | | | |
| A. READ<br>1. Divide 1/6 of class into this Center. If additional students are available they should be added to this group.<br>2. Have students read SC #23 (explanation for the "Jetport Controversy" simulation).<br>3. Have students select which roles they will play. Some students may have to play multiple roles. | A. READ<br>SC #23, p 64. | A. READ | A. READ<br>1. Prepare a copy of SC #23 and distribute to each student.<br>2. TC #5, p. 135, (Pros & Cons of the Everglades Jetport) provides background for this controversy. |
| B. STUDY<br>Have the students read and study SC #'s 24, 25, 26 and 27 as they prepare for performing their roles. | B. STUDY<br>SC # 24 (Selection of Location) p. 66.<br>SC #25 (Pro - Jetport) p. 69.<br>SC #26 (Population Growth) p. 72.<br>SC #27 (Anti-Jetport) p. 73. | B. STUDY<br>Award all students who complete the reading assignment 10 ESPs. | B. STUDY |
| C. PLAN/PRESENT<br>1. After reading is completed, plan details for the simulated public hearing on the Jetport.<br>2. Present to class later. | C. PLAN/PRESENT | C. PLAN/PRESENT<br>1. Award role-playing students from 50 - 100 ESPs based on the effectiveness of their acting.<br>2. Award ESPs to all students who discuss and debate issue. | C. PLAN/PRESENT<br>1. Remind students that as role-players they are all residents of South Florida and will be directly affected by the outcome of the "hearing."<br>2. If you do not have a class secretary, appoint one to |

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| | | 3. If the Review Team votes to continue to build the Jetport, all students lose 50 ESPs. If the Review Team votes not to build the Jetport, all students gain 50 ESPs. | record number of valid contributions from individual class members so that you may reward them for contributions. You might consider 5 ESPs per contribution as an incentive for students to get involved in this activity.<br>3. DO NOT tell the students that they will either gain or lose ESPs as the result of the Review Team's decision. This will serve as a surprise and as an illustration of how one gains or loses sometimes as the result of decisions of others.<br>4. The teacher might consider playing the role of either a supporter of the Jetport or of an opponent during the debate, however, if this is done the teacher must be sure that all students understand that the teacher is playing a role and that the things he says do not necessarily reflect either fact or even his own personal opinion. |

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| D. READ/DISCUSS<br>1. Following the presentation of the "public hearing" have the entire class read SC #28.<br>2. Conduct a general class discussion in which students react to the article as it relates to the "public hearing." | D. READ/DISCUSS<br>SC #28, p. 76, (Meanwhile Back in the Glades). | D. READ/DISCUSS<br>1. Award ESPs to students for valid contributions in class discussion of the article.<br>2. Have students write an essay in which they compare the Jetport case with the building of a housing project in a fresh water marsh. Ask, "Would the pro and anti arguments about the housing project be similar or different than those about the Jetport?" How similar? Award from 50 to 100 ESPs for essays. | D. READ/DISCUSS |

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| Learning Activities | Resources | Evaluation | Teacher Suggestions |
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| Investigation #8:<br>(Action Learning Center)<br><br>Activity Set #1:<br><br>A. READ<br>1. Divide 1/6 of class into this Center.<br>2. Have students read SC #'s 2-8.<br><br>B. CREATE<br>To demonstrate their opinions, outlook and feelings on the readings, have the students write out one of the following:<br>- a newspaper editorial written by an alligator<br>- a dialogue between an alligator and the manufacturer of alligator handbags<br>- a page from the diary of an Everglade Kite.<br><br>C. PLAN/PRESENT<br>1. Plan a way for these written materials to be acted out in skit-form.<br>2. Present to class later. | A. READ<br>SC #'s 2 - 8, pp. 30-47.<br><br>B. CREATE<br><br>C. PLAN/PRESENT | A. READ<br><br>B. CREATE<br>Collect and evaluate written assignments.<br><br>C. PLAN/PRESENT<br>Judge skits on content and originality. | Investigation 8 is divided into three sets of activities. You may have the students at this Center work through all three sets or only one of the sets.<br><br>A. READ<br><br>B. CREATE<br><br>C. PLAN/PRESENT |

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| **Learning Activities** | **Resources** | **Evaluation** | **Teacher Suggestions** |
| Activity Set #2:<br><br>A. EXAMINE/DRAW<br>1. Have students study SC #'s 29, 30, 31.<br>2. After examination of maps, have students draw in the following sections on SC # 11.<br>- major canals<br>- major highways<br>- water conservation areas<br>- agricultural zones<br>- national parks<br><br>B. DESIGN<br>1. Have students design a mock "Peace Talks" session in which they discuss this topic:<br>- needed changes in the present use of the Everglades<br>2. Have students represent the viewpoints of the following:<br>- the National Park<br>- a water conservation area<br>- an agricultural zone<br>- the Department of Transportation<br>- Corps of Engineers<br><br>C. ILLUSTRATE/PRESENT<br><br>1. Have students illustrate on chalkboard or on poster board the results of the Peace Talks. | A. EXAMINE/DRAW<br>1. SC #'s 29, 30, 31, pp. 80-82.<br><br>(Overlay-Maps 1871, 1971.)<br>2. SC #11, p. 50, (outline map of southern Florida).<br><br>B. DESIGN<br><br>C. ILLUSTRATE/PRESENT | A. EXAMINE/DRAW<br>Award 30 ESPs for accurate location on outline map.<br><br>B. DESIGN<br>Participation and discussion at Peace Talks merits 20 ESPs.<br><br>C. ILLUSTRATE/PRESENT<br>Allow 20 ESPs for the listed changes. | A. EXAMINE/DRAW<br><br>B. DESIGN<br><br>C. ILLUSTRATE/PRESENT |

Inquiry Question:

III – VIII

| Learning Activities | Resources | Evaluation | Teacher Suggestions |
|---|---|---|---|
| 2. Present the illustration to the class later.<br><br>Activity Set #3:<br><br>A. VIEW/DISCUSS/WRITE<br><br>1. Have students view SC # 31.<br>2. Having located the Gold Coast, have the students discuss the following statement:<br>- "As the Everglades goes, so goes the urbanized Gold Coast of Southeast Florida."<br>3. Write out a summary report of the discussed.<br><br>B. DRAW<br>Have students assume they are a common housefly and then draw a series of cartoons depicting the urban problems he sees in the Gold Coast.<br><br>C. DESCRIBE<br>1. Next have "student flies" visit the highway system of Southeast Florida (see SC #31).<br>2. Describe in written form the different highways as to quality, quantity, usefulness and accommodation. | A. VIEW/DISCUSS/WRITE<br>SC #31, p. 82.<br><br>B. DRAW<br><br>C. DESCRIBE<br>SC #31 p. 82. | A. VIEW/DISCUSS WRITE<br><br>B. DRAW<br>Award 20 ESPs for good cartoons.<br><br>C. DESCRIBE<br>Collect description and evaluate (20 possible ESPs). | A. VIEW/DISCUSS/WRITE<br><br>1. Encourage students to discuss the stresses on the urban portion of the ecosystem.<br>2. Background information can be found in The Florida Naturalist, August, 1972, p. 109.<br><br>B. DRAW<br>Possible problems: water shortages, power shortages, water/air pollution, others.<br><br>C. DESCRIBE |

Inquiry Question:
III – VIII

| Learning Activities | Resources | Evaluation | Teacher Suggestions |
|---|---|---|---|
| D. COMPARE<br>1. Have students write out a comparison of the following:<br>- which trip – across Southeast Florida highway system or through the Gold Coast – would be easier, more pleasant, more enlightening, more depressing. | D. COMPARE | D. COMPARE<br>Collect comparison and evaluate (20 possible ESPs). | D. COMPARE |
| E. PLAN/PRESENT<br>1. Have students plan a presentation of their cartoons, descriptions and comparisons.<br>2. Present to class later. | E. PLAN/PRESENT | E. PLAN/PRESENT<br>Award 20 ESPs for presentations well done. | E. PLAN/PRESENT |

Inquiry Question: III — VIII

| Learning Activities | Resources | Evaluation | Teacher Suggestions |
|---|---|---|---|
| Investigation #9:<br>(General Class Session)<br><br>A. PRESENT<br>1. Have each Learning Center group present the results of their investigation.<br>2. These presentations are made to the entire class.<br><br>B. DISCUSS/LIST<br>1. Following the presentations, divide class into small groups of from 6 to 10 students.<br>2. Each group will discuss and list answers to each of the following questions:<br>a) What is the definition of the ecosystem you have been investigating?<br>b) What are some of the biotic and abiotic features of the ecosystem?<br>c) What areas in the Everglades have undergone change?<br>d) What are some of the factors which have contributed to environmental change in the Everglades?<br>e) How was the environment changed by man/nature?<br>f) What were the results of the changes to the environment? | A. PRESENT<br><br>B. DISCUSS/LIST<br>1. All notes and materials used throughout the Everglades Survival Game.<br>2. Data presented by each Learning Center should be helpful. | A. PRESENT<br><br>B. DISCUSS/LIST<br>Award ESPs for participation in group's work. | A. PRESENT<br><br>B. DISCUSS/LIST<br>1. Inform students that they may use all information they have accumulated since the beginning of the study of the Everglades to help them in answering the questions.<br>2. Have each group select a leader and a recorder to take notes each day they meet. |

Inquiry Question: III – VIII

| Learning Activities | Resources | Evaluation | Teacher Suggestions |
|---|---|---|---|
| 1. beneficial<br>2. detrimental<br>g) If new changes are needed in the environment, what are they?<br>h) How might these changes to the environment be brought about? | | | |
| C. REPORT/DISCUSS<br><br>1. Each group's leader or recorder will report to the entire class the answers they agreed upon for each of the questions.<br>2. Have class discuss and agree upon best answers for questions. | C. REPORT/DISCUSS | C. REPORT/DISCUSS<br>1. Award ESPs for person reporting (Evaluation Form for Oral Report, TC #7, p. 142 ). | C. REPORT/DISCUSS<br><br>Encourage class to compare and contrast answers from each group. |

# STUDENT COMMENTS

STUDENT COMMENT NO. 1: Definition of a Marsh

A marsh is a shallow body of slow moving or still water whose surface is extensively broken with wate adapted vegetation. The shallow depths of a marsh generally teem with plankton and are abundant with aquatic life. Attracted by the rich food source and the protection of tall grasses and other water tolerant plants, aquatic birds are plentiful. Predatory mammals are also present.

STUDENT COMMENT NO. 2: Plant Life in the Everglades

Many different species of plants thrive within the confines of Everglades National Park and in adjacent regions. The characteristics of these plants are determined largely by three factors: hydrological factors, geological influences and temperature, which averages 68 in winter and 80 in summer.

Southern Florida may be divided into three major regions according to the nature of the dominant vegetation. The first region is the "true Everglades," a sawgrass swamp which covers most of the southeastern corner of the state. This area resembles a Kansas wheat field flooded by several feet of water. The vast sawgrass sea is interrupted by occasional stretches of pine forests and tree islands known as hammocks. Hammocks form in two ways: on naturally occurring patches of higher ground where the marl (clay) is thicker and higher than the surrounding marsh, and in depressions in the marl where decaying plant material has become peat, a rich soil nutrient for small plants which later give way to trees. Hammocks usually contain tropical hardwood trees such as mahogany, a wide variety of palms, and many other species, including a number of northern type trees such as oaks and maples. Along the forest floor grow ferns, orchids, ivies and fruit-bearing shrubs, forming a lush tropical oasis. Hammocks also provide an excellent environment for many species of wildlife.

Another factor which has influenced the development of the hammocks and sawgrass ever since Indians first inhabited the area is fires. During the dry season an Everglades fire is a savegly destructive force.

The sawgrass swamp is one of the most richly productive vegetative regions in the world. A measurement known as the "net primary productivity per unit area" is used to determine how much vegetation is produced. It is defined as the number of dry grams of green plant matter produced per square meter per year. In the sawgrass swamp this figure averages about 2000. In comparison, a temperate zone forest produces 1500, a cow pasture 500 and a desert 30. The average figure for the entire earth is 320. The only areas

which can compete with the marsh for richness of vegetation are estuaries, tropical forests and farmland managed scientifically.

The second major region in southern Florida lies to the west of the sawgrass swamp. Known as the Big Cypress Swamp, it is not within the boundaries of Everglades National Park. Around the turn of the century the most magnificent cypresses in the country grew here. Some were more than 15 feet in diameter at the base. Few of these giant trees remain; they were sacrificed to an unregulated timber industry. Nevertheless, the Big Cypress Swamp remains a vital part of the ecology of South Florida. Many species of birds and animals live in this area, which serves as an excellent breeding grounds. Some are on the Bureau of Sport Fisheries and Wildlife list of rare and endangered species. Among these are the wood ibis, the roseate spoonbill, the southern bald eagle, the Cape Sable seaside sparrow, the panther and the alligator.

The third region is found at the southern tip of the state where the waters of the Gulf of Mexico intermingle with the fresh water of the swamps. The dominant form of vegetation in this area is the mangrove tree. The red mangrove, one of the species found in the park, is equipped with a unique means of propagation. Water seedlings with a simple root system already formed drop from the parent plant into the water, where they float until they reach water shallow enough to take hold in the mud. In places the mangrove groves are so dense and intricate that canoeists have become lost for days.

-- Harte, John and Socolow, Robert, Patient Earth, Holt, Rinehart and Winston, Inc., New York, 1971. "The Everglades Dominant Plant Vegetation," pp. 186-188.

STUDENT COMMENT NO. 3: Can the Everglades Survive?

The Everglades National Park is, of course, protected against direct development. But what many don't realize is that the park itself is utterly dependent ecologically upon the regions adjacent to it, especially the large swamp of peat and muck known as the Upper Everglades which stretches across the state to the north of the park itself. The organic soils in the Upper Everglades are capable of absorbing and detoxifying large quantities of pollutants such as persistent pesticides and toxic metals from the waters which drain southward from urban and agricultural developments into the swamp. This area serves as a critical buffer zone. It decontaminates the polluted water and feeds clean water into Everglades National Park to the south. In addition, the spongy muck holds water during the wet season and then gradually releases during the dry season, thus serving as a delicate natural filtration network for the entire ecosystem of South Florida.

Now the Upper Everglades are rapidly being drained for economic development, both to reap bountiful crops from the rich organic soil (until it is depleted) and to build new communities for one of the most rapidly growing states in the nation. As a result, the vital beds of muck and organic soils are being systematically destroyed. In the last 50 years, 40 percent by volume of organic soils in the Upper Everglades has been destroyed. Exposed to the atmosphere by draining and farming, the muck has been eroding rapidly. In the Okeechobee agricultural area, the thickness of the muck has dropped five feet in the last 44 years. It is expected to be depleted entirely by 1990. As this critical buffer zone is destroyed, pollutants from urban and agricultural areas will flow directly into the Everglades, unimpeded. Inevitably, the park will be destroyed also, unless an immediate effort is made to preserve the ecology of the ENTIRE area, not just the federally-protected parkland.

-- The Florida Naturalist, Vol. 43, No. 4; Oct. 1970.

-- "Can the Everglades Damage Be Repaired?", The Florida Naturalist, Vol. 11, No. 1; Oct. 1971.

STUDENT COMMENT NO. 4: The Frontier Spirit in the Everglades

Florida was admitted to the Union in 1845. Some 70 years later real estate speculators from the north finally began to recognize the area's vast economic potential. In 1915 the Everglades swamp beckoned as a frontier to these fortune-hunters. Plans were drawn up to drain the swamp and create a "Garden of Eden" of fertile farmland. The drainage projects began. The sawgrass along the perimeter of the swamp was drying up under the hot sun. Farmers began to till the rich black peat.

As the area began to develop, there was increasing demand for a trans-Everglades highway to link the Miami area with the Gulf Coast. The proposed thoroughfare was dubbed "Tamiami Trail" by promoters, and the name caught on. A bond issue of $275,000 was passed. Construction began in 1916. The enormous enthusiasm which marked the early stages of the project began to wane, however, when it became evident that the original financial appropriation was hopelessly inadequate. Building a hundred miles of roadbed through the dense sawgrass and cypress swamps proved to be a Herculean endeavor indeed! The task was further delayed by World War I and all but shelved entirely in the aftermath of the devastating Miami hurricane of 1926. (See Student Comment No. 5, "Nature Strikes Back," p.35 ). The vicious storm halted, at least temporarily, the Florida boom. Then a new governor was elected, and the project was revived. The Tamiami Trail was finally completed in 1928 after 13 years of strenuous effort and at a total cost of some $7 million -- 29 times the amount allocated in the original bond issue! Few motorists who whiz along this black ribbon through the swamp today realize that effort and frustration went into its construction.

About 40 years later a second highway was constructed about 25 miles north of and running parallel to the Tamiami Trail. The new road was named Alligator Alley.

While the Tamiami Trail was still under construction, a political "hassle" developed between competing real estate interests as to which route the road should follow. It was originally to pass through

Monroe County -- in fact some of the roadbed had already been constructed there -- but after the power struggle the route was changed to transverse Collier County instead, to the north.

Everglades visitors today can benefit from the furor generated over the Tamiami Trail. Twenty-four miles of the original roadbed in Monroe County became a secondary route (Florida Highway 94) which offers a fascinating side trip into the heart of the swamp. The gravel surfaced Route 94 offers a much closer look at the Everglades vegetation and wildlife than the high-speed Tamiami Trail. It also leads to places where enterprising motorists can disembark and explore roadside hammocks for wild orchids and air plants.

-- Sand, George X., The Everglades Today - Endangered Wilderness, Four Winds Press, N.Y., 1971, Chapter 9, "The First Road Into the Swamp,"pp. 141-149.

STUDENT COMMENT NO. 5: Nature Strikes Back

Almost inevitably when man decides to "improve" on nature, he ends up making a mess of things. Such has been the case in southern Florida ever since the first settlement shortly after Florida joined the union in 1845. Settlers discovered that incredibly large, choice-quality vegetables would spring up in a matter of weeks from the rich black soil in the Everglades. Bright red tomatoes as big as melons and firm green cabbages as big as washtubs sprouted up almost without effort. But first the settlers had to cope with a little problem -- the thin layer of drainage water from Lake Okeechobee which blanketed the fertile peat that had taken thousands of years to accumulate. In their zeal to exploit the "black gold", farmers sought a means of draining the land.

Before man intruded, nature had created an ingeniously simple and effective watershed on the Florida peninsula. Almost all of the 60 inches of rain which descends upon the region during the spring and fall wet seasons flows southward down the peninsula through an intricate interlacing network of rivers, streams and lakes. The main artery is the Kissimee River, which empties into the north end of Lake Okeechobee. The lake serves as an immense catch basin for the entire region. From it, overflow waters seep into the Everglades to sustain its delicate life cycle and protect the precious peat.

Settlers who had difficulty draining the land began to exert pressure upon legislators. In 1850 Congress passed the Swamp Land Act, which made possible the transfer of large tracts of federal land to the states, to be used for the benefit of all citizens. Much of the Everglades thus became the property of the state of Florida. To assure that the area be developed sensibly, the Florida legislature in 1855 established the Internal Improvement Fund. A "watchdog" committee was set up to monitor the sale of public lands to private individuals. However, the IIF did not keep its trust to the citizens of Florida in those pioneer days, and it never really has fully discharged this responsibility. Originally the Everglades swamp covered some

2,746 square miles. Now only 1,537 square miles remain in a relatively natural state, and the area is still shrinking.

The Civil War temporarily interrupted the plans of settlers to drain large areas of the Everglades for agricultural purposes, but by 1906 dredges were carving up the terrain. The "battle plan" was to cut several deep drainage canals to drain water from Lake Okeechobee into both the Atlantic Ocean and the Gulf of Mexico. To make sure the lake would never again overflow, an earthen dike was constructed along the southern shore.

## ECOLOGICAL "BACKLASH"

The drainage project succeeded in exposing the rich black soil to the air. Farmers moved in eagerly, but to their chagrin they learned an early lesson in ecology. In a vast ecological "backlash" which has continued to this day, the Everglades protested against its intruders. First, the rich soil, baked dry by the sun (which had never been able to penetrate the naturally protective layer of water that man drained off), began to blow away in dense brown clouds. Ironically, much of the prized "black gold" began to wash away in the poorly-designed drainage canals. And what didn't blow away or wash away began to catch fire, sometimes from spontaneous combustion within the peat. Developers looked on in frustration as the peat began to shrink. As much as five feet disappeared in the first five years. The peat has continued to erode ever since. Conservationists estimate what remains will be lost forever within 30 or 40 years. Nor was farming as Utopian a task as the ads the real estate developers placed in newspapers across the country would have prospective farmers believe. Clearing the land of the saber-sharp sawgrass was a difficult, costly and sometimes impossible task. Even when the land was cleared successfully, farmers discovered that after one or two bumper crops the soil became depleted. Only with expensive fertilizers could additional farming be successful.

The damage done by the drainage canals was irreparable. Fires caused by lightning, careless people and spontaneous combustion raged out of control where once they had been controlled naturally by the surface

water in the swamp. Beautiful islands of trees were destroyed in seconds. Black smoke hung like a pall over the Everglades. Thousands upon thousands of fish died in slimy stagnant pools which had once contained crystally clear water. Deer fled, following the bear, panther and long-legged birds that had already departed. The Seminole Indians were thus deprived of two of their major sources of food. Even though man has attempted to repair some of this damage today, he has never been completely successful. Perhaps the most dangerous "backlash" of all was the threat of salt-water intrusion along the East coast. As the level of fresh water became depleted, ocean water began to filter in through the pores in the coastal ridge of limestone, poisoning the water supply of cities along the coast.

## THE FURY OF NATURE

The would-be exploiters of the Everglades were paying a bitter price. The punishment, it seemed, was contained in the crime. But in the 1920's it seemed almost as if nature was exacting further payment from the humans who had ravaged the swampland. In September, 1926, a violent hurricane struck the southern portion of Florida. Packing winds of up to 135 miles per hour, the storm churned Lake Okeechobee into a frothing cauldron which surged relentlessly against the tiny dike at the southern end of the lake. The great waves washed through the dike at the southwest shore and carried away the flimsy frame houses of the farmers in the vicinity of Moore Haven. The occupants struggled futilely. Their terrified screams were muffled by the fury of the storm. Many were washed into the fields they had farmed that afternoon and were never seen again.

Still, man clung tenaciously to the perilous south shore of the lake. An earthen levee about seven feet high was constructed along the shore. Life went on. Then, almost two years to the day from the first hurricane, a second and even more devastating storm struck Lake Okeechobee on September 16, 1928. This time the direction of the wind funneled the fury of the lake toward the weakest link -- the southeast corner, where 6000 people lived, protected only by the 7-foot levee. Frenzied by winds of up to 150 miles per hour,

the waters smashed through the barrier as if it were a sand castle on the beach and raced in a vast tidal wave across the flat land.

Men fighting to save their possessions were lifted off the ground by the screaming wind and hurled into the darkness. The wind was so strong it drove fragments of boards clear through tree trunks. Women and children clung in terror to the roofs of floating houses, but they often found they had to share their haven with equally terrified poisonous snakes trying to escape the flood. Weakened and dizzied by snake bites, many lost their grip and perished in the waves. When the hurricane finally subsided, bodies floated in all directions. Some were never recovered, entombed in the muck they had hoped would make their fortunes. Rescue teams had to pile unclaimed corpses in funeral pyres to be burned before they bred disease. Black smoke again draped the Everglades.

(The story of this region of the Everglades is continued in Student Comment No. 7 , "The Everglades - Dying of Thirst?", p. 42 ).

-- Sand, George X., The Everglades Today - Endangered Wilderness, Four Winds Press, N.Y., 1971, Chapter 8, "Man's Intruding Hand," pp. 133-139.

STUDENT COMMENT NO. 6: The Battle for Water in Southeast Florida

Supplying water for southeastern Florida is one of the most complex environmental problems in the nation. During the rainy spring and fall seasons, there is too much water, threatening farms and homes with floods. During the dry summer and winter periods, there is too little water, bringing danger of drought. To regulate the water supply in the area, the Army Corps of Engineers has constructed an intricate network of canals, dikes and drainage gates which criss-cross the eastern half of southern Florida like a vast cobweb. The system is administered by the Flood Control District. It can drain water from Lake Okeechobee to lessen the danger during flood season, let it stand on the ground, and later release it during the dry season. The underground pressure from the accumulated water protects the coastal water supply against invasion by salt water through the coastal limestone ridge.

There are three major interests competing for the water in the Flood Control District -- the rapidly growing metropolitan Miami-Fort Lauderdale-Palm Beach urban complex; agricultural interests (especially citrus growers), and the Everglades National Park to the south, which has been cut off from much of its natural water supply by the man-made system. Difficult priority decisions must be made when the supply of water is limited. The densly populated coastal area, which now packs over a million people into a narrow strip of land which contained less than half that number in 1950, places heavy demands on the water supply. Farmers are almost totally dependent upon irrigation to carry their crops through the dry season. Cities and farmers can talk. The Everglades cannot. This essential difference was probably a major factor in the decision of the FCD to virtually shut off the flow of fresh water to the Everglades in the dry years of 1961 to 1965. Considerable damage was caused to plants and animals in the park (See Student Comment No. 7 , "The Everglades - Dying of Thirst?", p. 42 ). The cities and the agricultural interests received an ample supply of water. The park got nothing.

What will happen if the population of southern Florida continues to grow? By the end of this decade, it will probably be necessary to choose between a water shortage in Miami, a reduced crop yield in the citrus groves, and drying up the Everglades. The pressure will first be felt in dry years, eventually in wet years as well. By the end of the 1980's, there may not be enough water to meet ANY of these demands without going to outside sources far away, at great expense. This warning is sometimes difficult to get across to the public, however, especially when it sees pictures of the Everglades covered with water during the rainy season. But the danger is real, and almost immediate.

## RECYCLING OF WATER: A POTENTIAL SOLUTION

One solution to the problem is re-cycling water for multiple use. Fields could be irrigated with waste water from cities; bath water could be cycled through air conditioning units, etc. However, multiple use is only practical when each successive use requires a lower degree of water quality. Water deteriorates with each use. The only alternative would be to install treatment facilities at an intermediate step to re-purify the water. The cost of such facilities, at present, would be prohibitive, but the development of a quick, inexpensive large-scale treatment process would be a tremendous asset to water conservation methods. Such a development would be essential for the Everglades to benefit from re-cycling projects, because the finely-balanced ecology of the swamp requires water of even higher quality than that necessary for public water supplies. (See Student Comment No. 8, "The Problem of Water Pollution in the Everglades," p.47 ). If water used to irrigate citrus groves were diverted from there to the Glades, the nitrates, phosphates and pesticides it had picked up would poison the park. In supplying water to the Everglades quality is just as important as quantity, a consideration which is certainly not going to work in favor of the park in the allocation of water resources in years ahead.

The Army Corps of Engineers has consistently demonstrated that the Everglades takes lowest priority in the distribution of water. Practically the only hope for the endangered tropical wilderness, therefore,

lies in the avenue of Congressional legislation. Since the federal government appropriates funds to the Corps, it has some influence on how the FCD apportions its water. In June, 1970, Congressmen concerned for the future of the Everglades passed a law establishing quantitative guidelines to guarantee at least a minimal annual water supply for the Everglades:

> Delivery of water from the central and southern Florida project to the Everglades National Park shall not be less than 315,000 acre feet annually, prorated according to the monthly schedule set forth in the National Park Service letter of October 20, 1967, to the Office of the Chief of Engineers, or 16.5 per centum of total deliveries from the project for all purposes, including the Park, whichever is less. (Public Law 91282, Section 2).[1]

Nevertheless, even a legal formula for water distribution will not save the Everglades if the population of the coastal area continues to skyrocket. The ecology of the area has already been strained to the breaking point; there is simply not enough water to go around. Further development of southeastern Florida will almost certainly sound the death knell for one of the nation's most beautiful and unique national parks.

-- Harte, John and Socolow, Robert H., Patient Earth, Holt, Rinehart and Winston, Inc., New York, 1971. "Competing Demands for Water in Southeast Florida, pp. 195-197.

Notes:

[1] p. 196

STUDENT COMMENT NO. 7: The Everglades - Dying of Thirst?

As ironic as it seems, the greatest problem facing the majestic swamp at Florida's southern tip is lack of water. How could a swamp, of all places, have gotten into such a predicament? The story dates back to the disastrous hurricane of 1928 which demolished the communities on the southeastern shore of Lake Okeechobee (See Student Comment No. 5, "Nature Strikes Back," p.35 ).

The national outcry which followed the hurricane of 1928 paved the way for action at a federal level. Newly-elected president Herbert Hoover made a personal inspection before his inauguration. At his order, early in the 1930's the Army Corps of Engineers began constructing a higher, stronger levee along the entire 80-mile south shore of Lake Okeechobee. It was known as Hoover Levee. Still, the project did not solve the problems caused by the early settlers who had tried to drain the Everglades. (See Student Comment No. 5, "Nature Strikes Back," p. 35 ). This became evident in 1947 when two severe hurricanes struck the Everglades in rapid succession. The swamp overflowed at its eastern border, causing some $60 million in flood damage to Miami and other coastal cities. Congressmen, supported by the Army Corps of Engineers, introduced a bill calling for the establishment of a Flood Control District. The bill passed in 1949. The project, to cost an estimated $300 million, was to be completed by 1965. Essentially, the plan called for the channeling of water from Lake Okeechobee before hurricane season to reduce the lake to below flood levels, and keeping it in three large reservoirs along the lower east coast, to be pumped out later during the dry season. The storage of the fresh water would protect the cities against salt-water intrusion from the sea and also create much-needed recreational areas. No fresh water was to be wasted. The plan appeared solid in principle, but it was not managed properly. The Corps took 10 years to build the three large impoundment areas for water, and even then the water continued to escape underground through the porous limestone rock at the southern areas of the reservoirs. The water levels were allowed to drop, sometimes disappear completely. As a result, thousands of bass and other choice freshwater

game fish perished. Carrion birds descended upon their carcasses.

## CONSERVATIONISTS BLAST ENGINEERS

Conservationists have charged that the Corps of Engineers is merely masquerading under a flood control program while fostering, in actuality, land reclamation designed to make profits for farmers in the gradually-drying Everglades. "Harold L. Ickes, who served as Secretary of the Interior under Presidents Truman and Roosevelt, once charged that, 'No more lawless or irresponsible federal group than the Corps of Army Engineers has ever attempted to operate in the U.S. either without or within the law...' "[1]

The FCD project has made the Everglades dependent upon man to release water during periods of drought to sustain its delicate ecology. By 1965 the park had suffered repeatedly from lack of water. Indignant citizens demanded that the FCD spare the unique national park. Finally, in reluctant response, the flood control agency opened briefly one of its four 6-gate spillways in the Tamiami Trail exactly one inch per week in order to feed fresh water into the Everglades. This amount of water was, of course, woefully inadequate to relieve the drought-parched swampland. One infuriated conservation organization called the FCD's action "... as helpful as spitting on a forest fire!"[2] FCD spokesmen retaliated that its critics were "... more interested in birds and alligators than people."[3] As the feud continued, the New York Times observed that by holding back water for the benefit of a few Florida farmers, the FCD was threatening a natural resource which belongs to all the people of the United States.

There is no doubt that the FCD has the capacity to provide the Everglades with all the water it needs. During and after Hurricane Donna in 1960 when the entire 16,000-square-mile pumping system was pressed into emergency operation, the system moved nearly half a trillion gallons of water ( 500 , 000, 000, 000, 000). And the Army Corps of Engineers is required by federal law to provide the Everglades National Park with a sufficient supply of fresh water. Yet by 1965 the Everglades appeared to be on the brink of extinction, as the vital water supply was deliberately choked off. Threatened by the slow death of the swamp were 89

different species of birds, 40 reptiles, 40 amphibians and 150 kinds of fish.

## A TRAGIC SCENE

Dying animals and birds searched pitifully for water, leaving broken trails in the drying mud where thousands of swollen dead fish were strewn. Vultures circled everywhere. Starving alligators were compelled to go against nature and devour their smaller brothers. Some species such as the otter and raccoon and many species of birds fled the Everglades in desperation, sometimes leaving their young to perish. The little white-tailed Glades deer refused to leave, however. Thousands died in agony from hunger and thirst.

Even during the drought, some water managed to work its way into the Everglades by seeping through the limestone and passing underneath the roadbed of the Tamiami Trail. This water, however, was insufficient both in quantity and quality; it was not nearly enough to revive the entire park, and it lacked the tiny microscopic organisms found in surface water which form the first link in the food chain of the swamp. Different attempts were made to furnish the drying Glades with water without relying on the FCD network. Wells were dug in an attempt to keep certain areas within the park flourishing, but the amount of water tapped was never fully adequate. There was also the threat of tapping high chloride water, which would do more harm than good. Cloudseeding operations using silver iodide have been successful on occasions, but the procedure is too expensive and results too unpredictable to be practiced on a large-scale basis. For all intents and purposes, the fate of the Everglades rested in the hands of the men who controlled the pumps in the South Central Florida Flood Control District. They clung stubbornly to their refusal to open wide the spillways through the Tamiami Trail and relieve the desperate situation in the Glades. The explanation was that the water had to be held back as part of the FCD's water conservation program. The effect of closing the spillways along the Tamiami Trail was to create a massive build-up of water in nearby conservation districts. This effect was increased by the impact of the other trans-Florida highway 25 miles north of

Tamiami Trail, Alligator Alley -- a road without spillways and with fewer than a dozen bridges in the 20-mile section where it cuts through the Everglades drainage route. As a result, in one portion of South Florida, deer and other game animals were being drowned by overflowing reservoirs, while in another section the same species were dying of thirst!

## NATURE DEFENDS HER OWN

Nature finally stepped in where man wouldn't. Heavy rains finally ended the 1965 drought. The park was saved. In a bitter touch of irony, however, many deer were drowned during the subsequent wet season, in the same area where animals had succumbed to thirst a few months before.

Despite the terrible impact of the 1965 drought upon the Everglades, the Army Engineers retained their same obstinate attitude when a second drought struck in 1967. Once again the Everglades, supplied with only a small portion of the water available, began to dry up. Once again, birds, animals, plants and fish died by the thousands. This time forest rangers angrily insisted the Engineers honor their legal commitment to preserve natural conditions in the national park. Not only did the Corps and the FCD refuse, but in a move which seemed to border on sheer vindictiveness, threatened to take an action which could destroy the Everglades in one fell swoop! They threatened to "pull the plug" on a controversial canal extension which they had dug through the Everglades earlier (itself a politically-motivated project, conservationists contended), and thus open up the Everglades fresh water system to direct invasion of salt water from the Atlantic Ocean! What the drought hadn't already killed, the salt water most certainly would. Ten miles long and 120-feet-wide, the canal was originally intended to serve as a navigable waterway which would permit barges to transport materials to a plant of the Aerojet General Corporation which had been constructed in the Everglades to test rocket engines. Called the Aerojet Canal (Canal III), the waterway cost $4 million. It was completed except for a small section of earth at the end which blocked out the sea. (Since the excavation of the canal, the

rocket-testing function of the plant has been discontinued.)

## NATIONAL PARK SERVICE INTERVENES

Now the Corps made preparations to remove the plug of earth, and flood the Everglades with salt water. That, however, was a little too much, even from the Army Corps of Engineers. The National Park Service protested. When the Engineers turned a deaf ear, the National Audubon Society threatened a lawsuit to safeguard the park against "irreparable damage and destruction."[4] The head of the FCD replied that if the plug were not removed forthwith, the money invested in the construction of the canal would "... be thrown down a rat hole."[5] The director of the National Park Service, George B. Hartzog, wrote a letter to Secretary of Interior Stewart Udall: "I recommend that if the Corps of Engineers of the State of Florida persists in their efforts to remove the existing plug in Canal III, the Department of Justice be requested to take legal action by means of an injunction in remedy of this situation."[6]

The plug was not pulled. Nevertheless, the perilous fortunes of the Everglades during the last decade lead conservationists to wonder what threat will next be levelled at this unique tropical ecosystem. Will it fall victim to an ill-guided "improvement" project? Will it be sacrificed for quick agricultural profit? And most important of all, will it receive enough water to survive in years to come? If the past performance of the Flood Control District and the Army Corps of Engineers is any indication, the troubles of the Everglades are long from over.

-- Sand, George X., The Everglades Today - Endangered Wilderness, Four Winds Press, N.Y., 1971, Chapter 10, "The Water Problem," pp. 151-161.

Notes

[1] p. 153
[2] p. 154
[3] p. 154
[4] p. 161
[5] p. 161
[6] p. 161

STUDENT COMMENT NO. 8: "The Problem of Water Pollution in the Everglades"

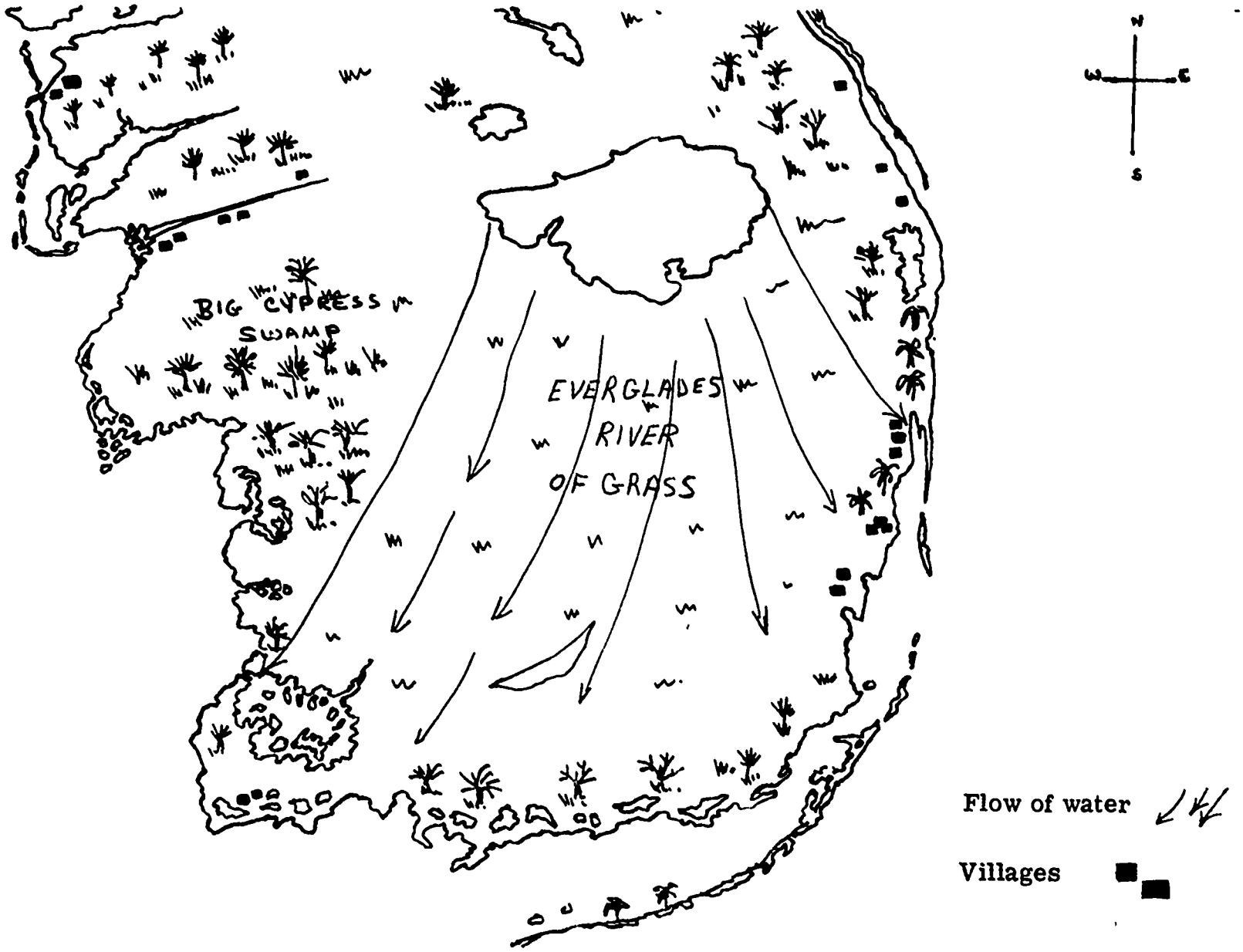
There are three primary causes of water pollution in the Everglades -- agricultural fertilizers, urban and industrial sewage and persistent chemical pesticides such as DDT. The first two sources contain nutrients such as nitrogen and phosphorus compounds. When these are washed into the waterways of the Everglades, they cause a phenomenon known as eutrophication, or the sudden heavy growth of vegetation. This sometimes clogs waterways to the point of destroying the natural habitat of creatures such as alligators and many species of fish. In its unspoiled state, the water of the Everglades contains 1.5 parts per million of nitrate ions and 0.1 ppm of phosphate ions. Waste waters from the urban areas of South Florida, even after receiving secondary treatment, contain 20-30 ppm of nitrate ions and 1 ppm of phosphate ions -- 10 to 20 times as much. Therefore, recycling waste water into the Everglades to combat drought will have the undesirable side effect of eutrophication, unless this water is subjected to tertiary treatment (which, at present, is a costly procedure).

The third cause of water pollution has already had a profound impact on the ecology of the Everglades. Studies have been made to determine the amount of contamination from pesticides such as DDT, DDD and DDE in the natural environment of the Everglades. In parts per billion, the findings are:

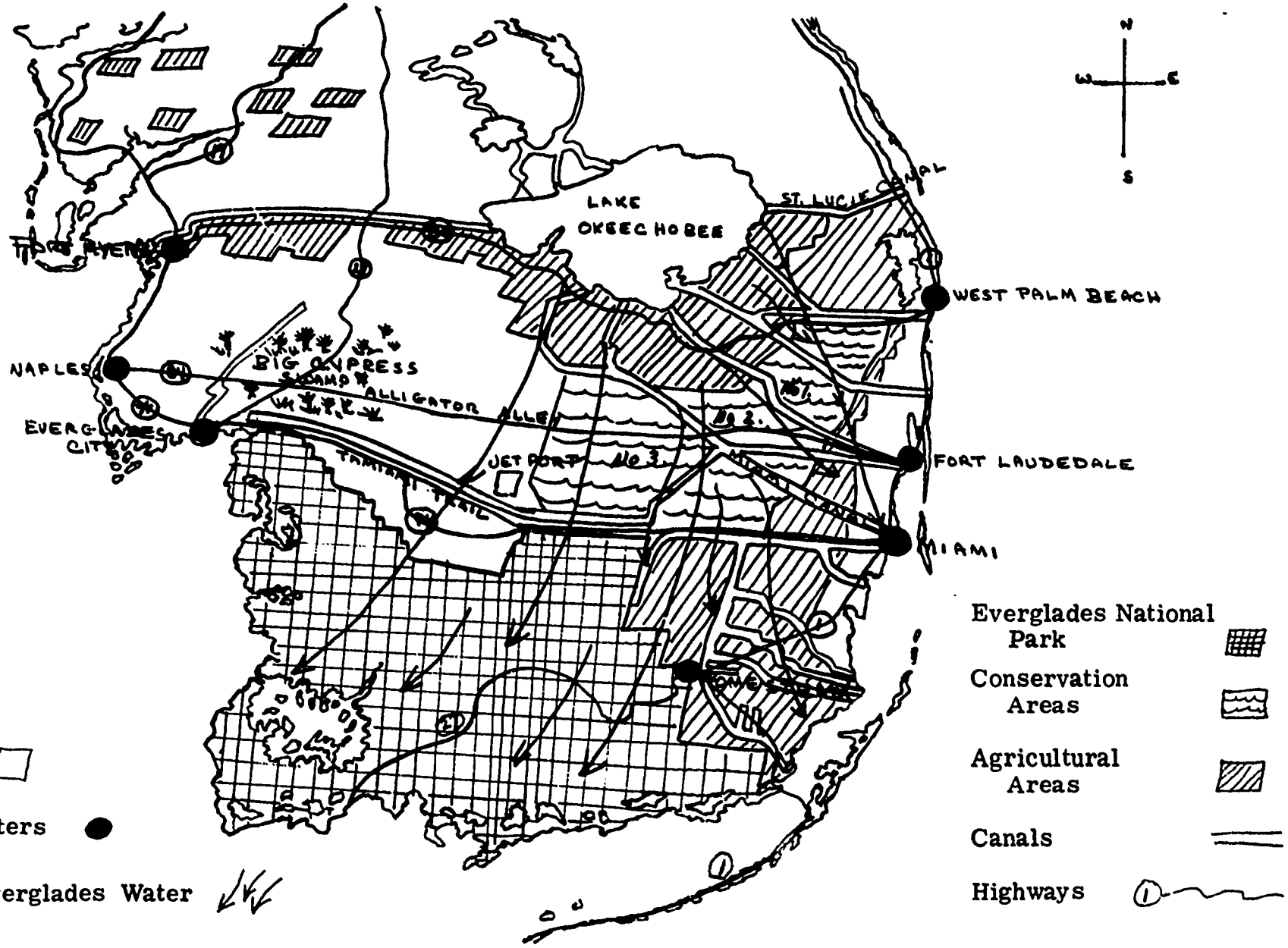
| | |
|---|---|
| Fresh and estuarine water | 0.02 |
| Rainfall | 0.08 |
| Marsh Soil | 40.00 |
| Algal mat | 200.00 |
| Small fish | 500.00 |
| Bald eagle | 8,000.00 |
| Brown pelican | 8,000.00 |

-- Harte, John and Socolow, Robert H., Patient Earth, Holt, Rinehart and Winston, Inc., New York, 1971. pp. 189-192

STUDENT COMMENT NO. 9: 1871 Map of Everglades



STUDENT COMMENT NO. 10: 1971 Map of Everglades



STUDENT COMMENT NO. 11: Outline Map of South Florida

STUDENT COMMENT NO. 12: Rainfall Factors for South Florida

The following data is compiled from Average Rainfall of the major cities in South Florida. Also included in the averages are data from rain gauges located in the heart of the Everglades.

| DATE | AVERAGE RAINFALL (Inches) | DATE | AVERAGE RAINFALL (Inches) |
|---|---|---|---|
| 1940 | 64.3 | 1953 | 69.9 |
| 1941 | 66.2 | 1954 | 67.9 |
| 1942 | 61.7 | 1955 | 44.9 |
| 1943 | 51.9 | 1956 | 40.5 |
| 1944 | 45.2 | 1957 | 68.8 |
| 1945 | 52.6 | 1958 | 66.4 |
| 1946 | 58.0 | 1959 | 81.2 |
| 1947 | 90.0 | 1960 | 68.7 |
| 1948 | 65.7 | 1961 | 41.5 |
| 1949 | 61.1 | 1962 | 51.6 |
| 1950 | 52.5 | 1963 | 52.4 |
| 1951 | 48.5 | 1964 | 60.7 |
| 1952 | 53.3 | 1965 | 55.0 |

Data from: Hydrologic Effects of Water Control and Management of Southwestern Florida, U S. Geological Survey, 1972.

STUDENT COMMENT NO. 13: Water Use in South Florida

| | YEAR | AVERAGE MILLIONS OF GALLONS PER DAY |
|---|---|---|
| Miami | 1960 | 96.8 |
| | 1965 | [illegible]1.1 |
| | 1970 | [illegible]1.1 |
| Fort Lauderdale | 1960 | 20.0 |
| | 1965 | 28.6 |
| | 1970 | 40.7 |
| West Palm Beach | 1960 | 11.7 |
| | 1965 | 13.9 |
| | 1970 | 17.0 |
| Total of all three | 1960 | 128.5 |
| | 1965 | 173.5 |
| | 1970 | 210.8 |

Source: Hydrologic Effects of Water Control and Management in Southeastern Florida, US Geological Survey, 1972.

STUDENT COMMENT NO. 14: "Water Control in Southern Florida"

The hydrology (water system) of southern Florida is a complex, delicately balanced regime which has undergone almost continuous changes since man first began heavy settlement of the area in the late 1800's.

The northern section of the Everglades, just south of Lake Okeechobee, was covered with a thick layer of peat which sustained a heavy growth of vegetation, especially sawgrass. During wet periods, water covered the entire surface, filtering slowly -- almost imperceptibly, overland through the dense vegetation. Much water evaporated. In the southern part of the Everglades, where the limestone bedrock protrudes in many places and the plant life is less dense, the overland flow of water is more rapid. Most of the water in the Everglades comes either from this southward filtering process or from rain falling directly upon the region.

Before any land was drained and reclaimed in the northern portion of the Everglades, during high water the water levels in Lake Okeechobee and those in the adjacent Everglades were probably identical. When water stages reached 15 feet, overflow from the lake probably took place first at two low places -- the Caloosahatchee River to the west, and a low-lying, narrow reach into the Everglades to the south. When water stages climbed to 18 feet, water overflowed in one flat, broad slough along the entire southern shore, moving into the sawgrass swamp and southward toward tidewater.

That was before man made any appreciable impact on the hydrological environment in the area. Modification of the watershed began as early as 1882, with the construction of drainage canals and levees around Lake Okeechobee. By 1883, a shallow canal linked the Caloosahatchee River to Lake Okeechobee. In 1905, man began to drain portions of the Everglades in order to reclaim the rich peat surface as fertile farmland. By 1921, four major canals had been dredged to connect the lake with the Atlantic Ocean. The eastern outlets were at Miami, Fort Lauderdale, Deerfield Beach and West Palm Beach. Hurricane gates were installed at the lake ends of these canals to prevent tidal overflow from hurricanes from inundating

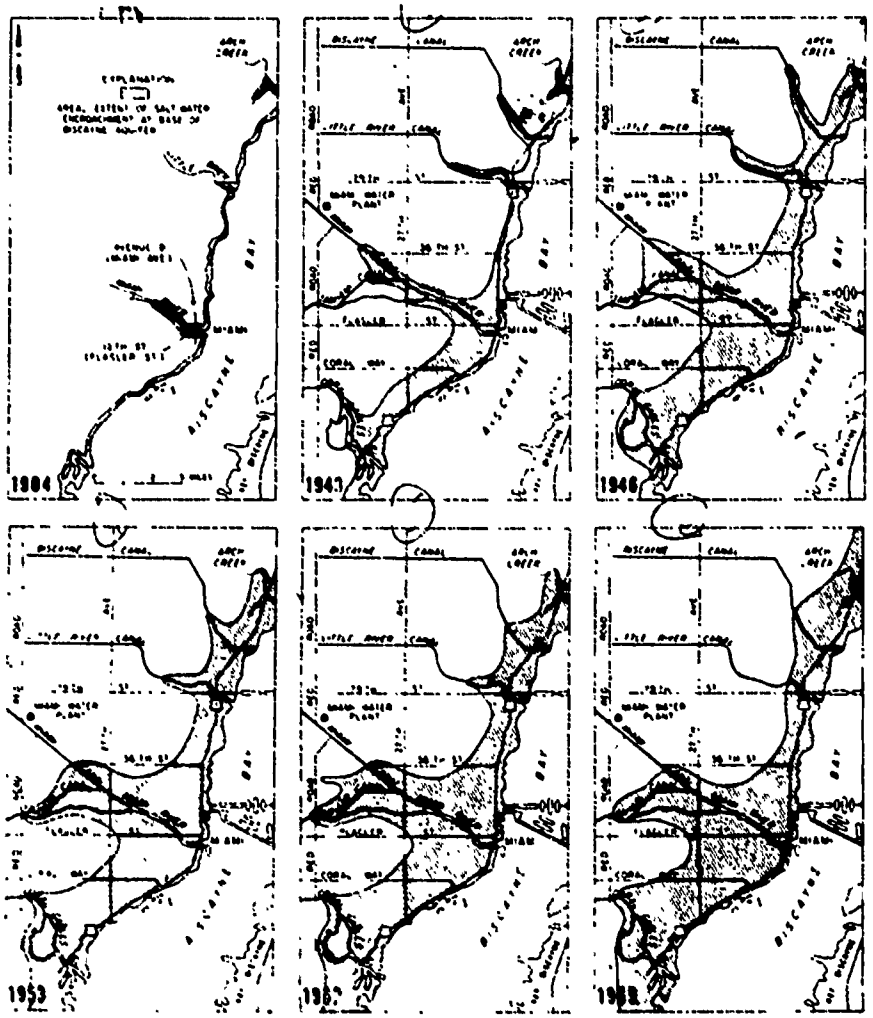
low-lying farmlands, and to contain Lake Okeechobee when its water level exceeded that of the adjacent drainage canals. In 1924, the St. Lucie Canal was completed (meeting the Atlantic at Stuart). This waterway became the chief controlled outlet from Lake Okeechobee from 1935-1946. The devastation inflicted upon the southern shore of the lake by two severe hurricanes (See Student Comment No. 5, "Nature Strikes Back," p. ) led to the construction of a new and much higher earthen dike along the east, south and west sides of the lake. Completed in 1938, the new levee was 85 miles long and from 34-38 feet high, several times the height of the former dike which had proven so insubstantial against the fury of the storm-lashed lake.

## FLOOD CONTROL SYSTEM INSTALLED

As more and more land south and east of Lake Okeechobee was reclaimed for agriculture, increasingly larger areas came under the flood control program. Drainage was thorough, and a large part of the overland flow in the Everglades was diverted through the canal system to the ocean. Most of the network of drainage canals had been completed by 1932.

Problems arose during periods in the 1930's and 1940's when uncontrolled or inadequately controlled drainage poured too much precious fresh water into the Atlantic. The result was a damaging intrusion of salt water into the Biscayne area water table (see maps on following page). After the drought in 1943-1945, the larger canals were equipped with control devices which could discharge fresh water during the rainy season and retain it during dry spells to resist the encroachment of saline water. However, further weaknesses in the system were revealed when the heavy rains of 1947 caused widespread flooding in urban and agricultural areas of southeast Florida. This led to the establishment in 1949 of the Central and South Florida Flood Control District, which was designed both to control flooding during wet periods and to conserve fresh water for periods of drought. Working in collaboration with the Army Corps of Engineers, the

FCD was developed during the 1920's. Water conservation areas #1 and #2 were enclosed by levees in Palm Beach and Broward Counties.




Maps of the Miami area in eastern Dade County showing the sea-water encroachment at the base of the Biscayne aquifer 1904-69 (Parker, Ferguson, Love, and others, 1955, p. 589, Kohout, 1961, Leach and Grantham, 1966) updated

-- Hampton, E.R., Klein, Howard, and Leach, S.S., U.S. Geological Survey, Hydrologic Effects of Water Control and Management of Southeastern Florida, Tallahassee, Fla., 1972, "History of Water Control Works," pp. 21-23.

STUDENT COMMENT NO. 16: Everglades Rainfall Readings (in inches) for 1948 - 1971
(Taken at 40 Mile Bend raingauge station near Tamiami Trail)

| YEAR | JAN. | FEB. | MAR. | APR. | MAY | JUNE | JULY | AUG. | SEPT. | OCT. | NOV. | DEC. | YEAR TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1948 | 1.48 | 0.70 | 0.05 | 3.67 | 2.61 | 1.67 | 5.84 | 11.95 | 19.30 | 10.59 | 0.20 | 0.41 | 58.47 |
| 1949 | 0.12 | 1.30 | 0.23 | 3.45 | 5.15 | 10.83 | 15.09 | 9.25 | 14.12 | 6.61 | 0.79 | 2.32 | 69.26 |
| 1950 | 0.04 | 0.75 | 2.32 | 3.75 | 4.12 | 4.90 | 8.06 | 9.99 | 9.59 | 8.89 | 2.10 | 2.45 | 56.96 |
| 1951 | 1.15 | 1.62 | 0.89 | 4.53 | 1.93 | 1.99 | 8.70 | 6.92 | 3.16 | 6.23 | 0.67 | 0.60 | 38.39 |
| 1952 | 1.59 | [illegible] | 1.97 | 1.17 | 7.60 | 8.70 | e. 9.74 | 6.30 | 7.45 | 8.80 | 0.40 | 0.05 | E. 56.34 |
| 1953 | 3.17 | 2.00 | 2.62 | e. 5.55 | 3.17 | 7.54 | 9.57 | 7.66 | e. 15.57 | 4.72 | 0.68 | 1.24 | E. 63.49 |
| 1954 | 0.23 | 1.48 | 2.78 | 3.84 | 6.67 | 8.74 | 7.24 | 5.21 | 10.16 | 0.98 | 1.98 | 0.68 | 49.99 |
| 1955 | 0.73 | 0.44 | 0.45 | 2.44 | 6.89 | 9.77 | 6.58 | 3.32 | 10.40 | 2.32 | 1.25 | 1.54 | 46.13 |
| 1956 | 1.34 | 0.58 | 0.87 | 3.21 | 1.36 | 6.16 | 6.98 | 7.78 | 6.61 | 7.73 | 0.19 | 0.16 | 42.97 |
| 1957 | 0.37 | 4.05 | 1.91 | 4.60 | 6.53 | 7.48 | 10.26 | E. 12.33 | 11.51 | 6.86 | 0.34 | 1.98 | E. 68.22 |
| 1958 | 6.11 | 1.18 | 5.55 | 0.58 | 11.72 | 11.53 | 7.49 | 4.02 | 3.29 | 4.59 | 0.34 | 2.93 | 59.33 |
| 1959 | 2.04 | 0.32 | 5.57 | 1.64 | 10.84 | 12.88 | 6.29 | 7.54 | 8.61 | 5.23 | 5.58 | 0.64 | 67.18 |
| 1960 | 0.07 | 2.19 | 1.19 | 6.98 | 3.29 | 8.86 | 12.66 | 9.89 | 19.05 | 7.23 | 1.91 | 0.59 | 73.91 |
| 1961 | 1.34 | E. 0.98 | 0.98 | 0.50 | 7.05 | 7.65 | 6.10 | 9.37 | 4.76 | 4.68 | 0.55 | 0.09 | E. 44.05 |
| 1962 | 1.46 | 0.50 | 3.65 | 0.73 | 6.36 | 18.78 | 4.87 | 3.80 | 10.91 | 3.27 | 1.34 | 0.39 | 56.06 |
| 1963 | 0.61 | 3.78 | 1.52 | 0.66 | 8.29 | 5.54 | 8.49 | 11.22 | 12.35 | 4.02 | 2.67 | 3.26 | 62.41 |
| 1964 | 1.00 | 1.54 | 2.03 | 4.36 | 4.37 | 10.36 | 3.79 | 10.50 | 9.13 | 6.48 | 0.79 | 0.93 | 55.28 |
| 1965 | 1.42 | 2.71 | 1.33 | 1.98 | 2.36 | 7.24 | 7.55 | 7.78 | 8.60 | 5.52 | 2.38 | 0.62 | 49.49 |
| 1966 | 4.53 | 1.35 | 0.76 | 2.84 | 6.97 | 13.15 | 8.00 | 7.23 | 10.04 | 5.34 | 0.50 | 0.75 | 61.46 |
| 1967 | 1.88 | 1.17 | 2.81 | 0.10 | 2.76 | 14.06 | 5.86 | 5.22 | 8.34 | 7.69 | 2.16 | 1.47 | 53.52 |
| 1968 | 1.22 | 1.76 | 1.59 | 0.55 | 16.69 | 14.11 | 5.22 | 8.11 | 6.91 | 8.97 | 1.78 | 0.03 | 66.84 |
| 1969 | 3.15 | 1.88 | 2.05 | 3.49 | 4.01 | [illegible] 1.48 | 6.34 | 5.58 | 11.51 | 11.75 | 0.54 | 1.33 | 75.11 |
| 1970 | 2.85 | 1.68 | [illegible] | e. T | 5.39 | 8.37 | 3.29 | 3.73 | 4.23 | 9.93 | 0 | 0.19 | e. 47.46 |
| 1971 | 0.78 | 0.80 | 0.41 | 0 | 3.18 | 6.81 | 3.70 | 7.93 | 6.54 | 5.68 | 0.89 | 1.70 | 38.42 |

STUDENT COMMENT NO. 17: Everglades Water Discharge Readings for 1963 - 1973

(Taken at water control gates 5-12)

| CALENDAR YEAR | JAN. | FEB. | MAR. | APR. | MAY | JUNE | JULY | AUG. | SEPT. | OCT. | NOV. | DEC. | YEAR TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | * 0 |
| 1964 | 0 | 0 | 0 | 56 | 811 | 2,530 | 1,570 | 0 | 0 | 0 | 0 | 0 | 4,970 |
| 1965 | 2,260 | 0 | 0 | 93 | 0 | 0 | 0 | 725 | 3,460 | 5,720 | 21,700 | 2,980 | 36,940 |
| 1966 | 1,320 | 5,780 | 43,490 | 41,750 | 42,360 | 67,770 | 200,300 | 242,500 | 165,600 | 159,900 | 35,690 | 0 | 1,006,000 |
| 1967 | 9,130 | 7,760 | 16,310 | 10,640 | 6,280 | 7,750 | 17,720 | 33,440 | 29,520 | 18,490 | 16,380 | 7,860 | 181,080 |
| 1968 | 9,350 | 7,630 | 6,240 | 4,830 | 5,430 | 91,520 | 248,000 | 269,100 | 179,700 | 113,500 | 59,330 | 16,370 | 1,011,000 |
| 1969 | 15,850 | 26,620 | 85,450 | 91,850 | 97,230 | 178,800 | 218,000 | 197,400 | 182,400 | 173,510 | 269,060 | 218,180 | 1,769,800 |
| 1970 | 126,510 | 152,250 | 182,480 | 186,620 | 67,150 | 138,270 | 124,380 | 67,640 | 24,530 | 68,880 | 56,010 | 37,800 | 1,232,500 |
| 1971 | 22,600 | 9,970 | 4,160 | 1,550 | 2,670 | 2,250 | 7,505 | 11,450 | 31,900 | 54,500 | 58,450 | 36,460 | 240,000 |
| 1972 | 23,180 | 10,160 | 3,950 | 1,280 | 10,800 | 33,380 | 30,650 | 14,500 | 38,470 | 55,150 | 48,080 | 36,220 | 309,550 |

U. S. Geological Survey

## STUDENT COMMENT NO. 18: Everglades Water Level Readings (in feet) for the Year Ending September 1963

(Taken at Everglades P-33 water level gauge)

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.17 | 5.82 | 5.73 | 5.50 | 5.27 | 5.22 | 4.06 | a 3.40 | 4.27 | 5.25 | 5.41 | 5.71 |
| 2 | 6.12 | 5.81 | 5.72 | 5.49 | 5.26 | 5.21 | 4.06 | a 3.40 | 4.21 | 5.22 | 5.39 | 5.74 |
| 3 | 6.12 | 5.83 | 5.72 | 5.48 | 5.24 | 5.19 | 4.02 | a 3.40 | 4.56 | 5.19 | 5.40 | 5.72 |
| 4 | 6.11 | 5.81 | 5.71 | 5.47 | 5.27 | 5.16 | 4.00 | a 3.40 | 5.17 | 5.20 | 5.43 | 5.70 |
| 5 | 6.10 | 5.80 | 5.70 | 5.46 | 5.27 | 5.14 | a 4.00 | a 3.40 | 5.34 | 5.25 | 5.42 | 5.69 |
| 6 | 6.08 | 5.79 | 5.70 | 5.46 | 5.25 | 5.11 | a 3.90 | a 3.40 | 5.34 | 5.23 | 5.41 | 5.67 |
| 7 | 6.05 | 5.78 | 5.69 | 5.45 | 5.23 | 5.08 | a 3.90 | a 3.40 | 5.32 | 5.21 | 5.39 | 5.65 |
| 8 | 6.02 | 5.77 | 5.68 | 5.46 | 5.21 | 5.04 | a 3.90 | a 3.30 | 5.30 | 5.21 | 5.37 | 5.64 |
| 9 | 6.00 | 5.87 | 5.68 | 5.46 | 5.19 | 5.02 | a 3.90 | a 3.30 | 5.28 | 5.17 | 5.35 | 5.64 |
| 10 | 5.98 | 5.90 | 5.67 | 5.45 | 5.17 | 5.00 | a 3.90 | a 3.30 | 5.27 | 5.13 | 5.33 | 5.63 |
| 11 | 5.96 | 5.89 | 5.66 | 5.44 | 5.15 | 4.97 | a 3.90 | a 3.20 | 5.26 | 5.17 | 5.31 | 5.63 |
| 12 | 5.94 | 5.88 | 5.65 | 5.44 | 5.21 | 4.93 | a 3.80 | a 3.20 | 5.25 | 5.30 | 5.28 | 5.61 |
| 13 | 5.94 | 5.87 | 5.63 | 5.43 | 5.25 | 4.89 | a 3.80 | a 3.20 | 5.30 | 5.37 | 5.32 | 5.59 |
| 14 | 5.94 | 5.86 | 5.62 | 5.42 | 5.22 | 4.86 | a 3.80 | a 3.10 | 5.28 | 5.38 | 5.36 | 5.57 |
| 15 | 5.92 | 5.85 | 5.62 | 5.42 | 5.20 | 4.82 | a 3.80 | a 3.10 | 5.27 | 5.39 | 5.34 | 5.57 |
| 16 | 5.89 | 5.85 | 5.61 | 5.41 | 5.17 | 4.78 | a 3.80 | a 3.00 | 5.26 | 5.38 | 5.30 | 5.57 |
| 17 | 5.87 | 5.84 | 5.60 | 5.41 | 5.34 | 4.74 | a 3.70 | 2.89 | 5.24 | 5.38 | 5.45 | 5.55 |
| 18 | 5.86 | 5.84 | 5.60 | 5.40 | 5.33 | 4.70 | a 3.70 | 2.81 | 5.20 | 5.37 | 5.53 | 5.55 |
| 19 | 5.84 | 5.83 | 5.59 | 5.39 | 5.33 | 4.65 | a 3.70 | 2.71 | 5.17 | 5.35 | 5.64 | 5.56 |
| 20 | 5.82 | 5.83 | 5.59 | 5.38 | 5.32 | 4.60 | a 3.70 | 2.62 | 5.12 | 5.34 | 5.73 | 5.66 |
| 21 | 5.81 | 5.82 | 5.58 | 5.38 | 5.30 | 4.53 | a 3.70 | 2.54 | 5.09 | 5.31 | 5.79 | 5.73 |
| 22 | 5.79 | 5.81 | 5.56 | 5.37 | 5.29 | 4.46 | a 3.60 | 2.48 | 5.05 | 5.29 | 5.78 | 5.77 |
| 23 | 5.78 | 5.80 | 5.57 | 5.36 | 5.27 | 4.41 | a 3.60 | 2.43 | 5.07 | 5.27 | 5.78 | 5.87 |
| 24 | 5.78 | 5.78 | 5.56 | 5.35 | 5.27 | 4.36 | a 3.60 | 2.39 | 5.12 | 5.24 | 5.80 | 6.01 |
| 25 | 5.76 | 5.78 | 5.56 | 5.34 | 5.26 | 4.32 | a 3.60 | 2.38 | 5.11 | 5.21 | 5.76 | 6.28 |
| 26 | 5.74 | 5.77 | 5.55 | 5.34 | 5.26 | 4.27 | a 3.60 | 2.34 | 5.12 | 5.22 | 5.76 | 6.30 |
| 27 | 5.73 | 5.75 | 5.54 | 5.33 | 5.26 | 4.23 | a 3.50 | 2.30 | 5.19 | 5.18 | 5.76 | 6.28 |
| 28 | 5.71 | 5.74 | 5.53 | 5.32 | 5.24 | 4.19 | a 3.50 | 2.25 | 5.30 | 5.15 | 5.73 | 6.27 |
| 29 | 5.70 | 5.74 | 5.53 | 5.31 | | 4.14 | a 3.50 | 2.68 | 5.29 | 5.28 | 5.70 | 6.23 |
| 30 | 5.72 | 5.73 | 5.52 | 5.29 | | 4.10 | a 3.50 | 4.38 | 5.28 | 5.48 | 5.67 | 6.19 |
| 31 | 5.64 | | 5.51 | 5.28 | | 4.07 | | 4.33 | | 5.45 | 5.67 | |

U. S. Geological Survey

STUDENT COMMENT NO. 19: Everglades Water Level Readings (in feet) for the Year Ending September 1967

(Taken at Everglades P-33 water level gauge)

| DAY | OCT. | NOV. | DEC. | JAN. | FEB. | MAR. | APR. | MAY | JUNE | JULY | AUG. | SEPT. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.89 | 6.85 | 6.27 | 5.86 | 5.74 | 5.65 | 5.46 | 4.71 | 5.32 | 5.80 | 5.75 | 5.95 |
| 2 | 6.88 | 6.83 | 6.25 | 5.85 | 5.73 | 5.64 | 5.45 | 4.66 | 5.33 | 5.86 | 5.74 | 5.94 |
| 3 | 6.86 | 6.80 | 6.22 | 5.84 | 5.72 | 5.63 | 5.45 | 4.61 | 5.33 | 5.87 | 5.74 | 5.93 |
| 4 | 6.85 | 6.78 | 6.20 | 5.83 | 5.72 | 5.63 | 5.45 | 4.56 | 5.33 | 5.90 | 5.75 | 5.97 |
| 5 | 6.87 | 6.77 | 6.19 | 5.81 | 5.71 | 5.63 | 5.44 | 4.51 | 5.35 | 5.88 | 5.77 | 5.97 |
| 6 | 6.89 | 6.75 | 6.17 | 5.80 | 5.71 | 5.62 | 5.44 | 4.47 | 5.42 | 5.89 | 5.81 | 5.97 |
| 7 | 6.90 | 6.75 | 6.16 | 5.79 | 5.70 | 5.61 | 5.43 | 4.43 | 5.46 | 5.92 | 5.84 | 5.99 |
| 8 | 6.90 | 6.75 | 6.14 | 5.78 | 5.72 | 5.63 | 5.42 | 4.39 | 5.47 | 5.90 | 5.86 | 5.98 |
| 9 | 6.90 | 6.74 | 6.13 | 5.77 | 5.78 | 5.66 | 5.41 | 4.34 | 5.46 | 5.87 | 5.87 | 5.96 |
| 10 | 6.91 | 6.73 | 6.11 | 5.76 | 5.78 | 5.65 | 5.40 | 4.28 | 5.46 | 5.84 | 5.88 | 5.96 |
| 11 | 6.91 | 6.71 | 6.09 | 5.75 | 5.77 | 5.64 | 5.40 | 4.23 | 5.46 | 5.82 | 5.92 | 5.95 |
| 12 | 6.88 | 6.70 | 6.09 | 5.74 | 5.76 | 5.63 | 5.38 | 4.18 | 5.54 | 5.79 | 5.96 | 5.94 |
| 13 | 6.86 | 6.69 | 6.08 | 5.73 | 5.81 | 5.62 | 5.37 | 4.13 | 5.63 | 5.77 | 5.96 | 5.94 |
| 14 | 6.85 | 6.67 | 6.06 | 5.73 | 5.79 | 5.61 | 5.36 | 4.08 | 5.75 | 5.75 | 5.98 | 5.95 |
| 15 | 6.83 | 6.64 | 6.05 | 5.73 | 5.78 | 5.60 | 5.35 | 4.02 | 5.73 | 5.73 | 5.99 | 5.95 |
| 16 | 6.81 | 6.61 | 6.03 | 5.80 | 5.77 | 5.59 | 5.33 | 3.98 | 5.77 | 5.71 | 5.98 | 6.02 |
| 17 | 6.80 | 6.59 | 6.02 | 5.78 | 5.76 | 5.57 | 5.31 | 4.21 | 5.90 | 5.70 | 5.97 | 6.07 |
| 18 | 6.79 | 6.57 | 6.01 | 5.77 | 5.75 | 5.57 | 5.29 | 4.68 | 5.91 | 5.68 | 5.97 | 6.05 |
| 19 | 6.78 | 6.55 | 6.00 | 5.77 | 5.74 | 5.55 | 5.27 | 4.61 | 5.93 | 5.67 | 5.96 | 6.03 |
| 20 | 6.76 | 6.53 | 5.98 | 5.77 | 5.73 | 5.54 | 5.24 | 4.54 | 5.96 | 5.65 | 5.95 | 6.02 |
| 21 | 6.79 | 6.50 | 5.97 | 5.76 | 5.72 | 5.53 | 5.20 | 4.49 | 5.92 | 5.64 | 5.94 | 6.02 |
| 22 | 7.05 | 6.48 | 5.96 | 5.80 | 5.72 | 5.52 | 5.17 | 4.44 | 5.88 | 5.62 | 5.94 | 6.00 |
| 23 | 7.10 | 6.45 | 5.95 | 5.79 | 5.71 | 5.49 | 5.14 | 4.86 | 5.84 | 5.62 | 5.94 | 5.99 |
| 24 | 7.06 | 6.42 | 5.94 | 5.80 | 5.70 | 5.49 | 5.10 | 4.88 | 5.83 | 5.65 | 5.93 | 6.00 |
| 25 | 7.02 | 6.40 | 5.92 | 5.80 | 5.69 | 5.48 | 5.06 | 4.82 | 5.84 | 5.69 | 5.92 | 6.01 |
| 26 | 6.99 | 6.38 | 5.91 | 5.79 | 5.67 | 5.46 | 5.03 | 4.77 | 5.81 | 5.75 | 5.94 | 6.01 |
| 27 | 6.94 | 6.35 | 5.90 | 5.78 | 5.66 | 5.44 | 4.98 | 4.72 | 5.80 | 5.84 | 5.99 | 6.03 |
| 28 | 6.93 | 6.33 | 5.89 | 5.78 | 5.66 | 5.42 | 4.93 | 4.81 | 5.77 | 5.79 | 5.98 | 6.06 |
| 29 | 6.90 | 6.31 | 5.88 | 5.76 | ----- | 5.44 | 4.86 | 5.08 | 5.77 | 5.77 | 5.96 | 6.10 |
| 30 | 6.94 | 6.29 | 5.87 | 5.75 | ----- | 5.45 | 4.77 | 5.05 | 5.79 | 5.75 | 5.95 | 6.13 |
| 31 | 6.86 | ----- | 5.86 | 5.74 | ----- | 5.46 | ----- | 5.14 | ----- | 5.75 | 5.96 | ----- |
| Max | 7.10 | 6.85 | 6.27 | 5.86 | 5.81 | 5.66 | 5.46 | 5.14 | 5.96 | 5.92 | 5.99 | 6.13 |
| Min | 6.76 | 6.29 | 5.86 | 5.73 | 5.66 | 5.42 | 4.77 | 3.98 | 5.32 | 5.62 | 5.74 | 5.93 |

U. S. Geological Survey

STUDENT COMMENT NO. 20: Water Control Data Chart

| Year[1] | Rainfall[2] (Yearly total in inches) | Water Discharge[3] (yearly total in acre-feet)* | Gauge (water) Height[4] (Readings in feet) | |
|---|---|---|---|---|
| | | | Lowest | Highest |
| | | | | |

* 1 acre-foot = 43,560 cubic feet

[1] Data for columns 1 and 2 given in calendar year while other columns given in water year.

[2] Readings taken at 40 Mile Bend Rain-gauge Station.

[3] Readings taken at Flood Control Water Gates.

[4] Readings taken at Everglades P-33 water level gauge.

STUDENT COMMENT NO. 21: Rare and Endangered Fish and Wildlife of the United States

BIRDS

Rare and Endangered Birds

Florida Great White Heron
Florida Everglade Kite (Florida Snail Kite)
Short-tailed Hawk
Southern Bald Eagle
American Peregrine Falcon
Florida Sandhill Crane
Cape Sable Sparrow

Peripheral Birds

Eastern Reddish Egret
Wood Ibis
Roseate Spoonbill
Atlantic Sooty Tern
Atlantic Noddy Tern
Florida Mangrove Cuckoo
West Indian Nighthawk
Cuban Black-whiskered Vireo
Cuban Yellow Warbler

Status - Undetermined Birds

American Osprey

MAMMALS

Rare and Endangered Mammals

Florida Panther
Florida Manatee or Florida Sea Cow

Status - Undetermined Mammals

Florida Water Rat or Round-tailed Muskrat
Everglades Mink

REPTILES AND AMPHIBIANS

Rare and Endangered Reptiles

American Alligator

Peripheral Reptiles

American Crocodile
Green Turtle

STUDENT COMMENT NO. 22: Species of the Everglades

BIRDS (163 Species - some listed below)

Roseate Spoonbill
Anhinga or Water Turkey
Purple Galinule
Coot
Everglades Kite
Bald Eagle
Marsh Hawk
Limpkin
American Egret
Snowy Egret
Sand Hill Crane
Pelicans (2)
Cormorant
White Ibis
Blue Heron
Louisiana Heron
Common Egret
Frigate Bird
Red Shouldered Hawk
Stilt
Swallow-tailed Kite
Boat-tailed Grackle
Pileated Woodpecker
Wood Stork
Vultures
Osprey
Barred Owl
Great White Heron
Little Blue Heron
Wood Ibis
Least Sandpiper
Sooty Terns
Ruddy Turnstone
Great Blue Heron
Glossy Ibis

MAMMALS (13 species - some listed below)

Cougar or Panther
Bobcat
Raccoon
White-tailed Deer
Mangrove Squirrel
Marsh Rabbit
Round-tailed Muskrat
Opossum
Otter
Cotton Rat
Red Fox
Sea Cow or Manatee

REPTILES (42 species - some listed below)

Green Snake
Everglades Racer
Indigo
Everglades Rat Snake
Everglades Swamp Snake
Banded Water Snake
Water Moccasin
Eastern Diamondback
Pigmy Rattler
Turtles (several)
Lizards (several)
Alligators
Green Turtle

FISH FOOD CROP FOR WADING BIRDS
(7 most important)

Least Killifish
Mosquito fish (Gambusia)
Blue-fin Killifish
Flag Fish
Golden Topminnow
Pigmy Sunfish
Blue Spotted Sunfish

OTHERS

Frogs (many)
Siren
Mosquito Fish
Longnose Gar
Tarpon
Snook
Black Bass
Mangrove Snapper
Numerous Insects (most prominent mosquitoes of a tremendous variety)
Shrimp
Crayfish
Florida Gar
Large Mouth Bass
Bluegill
Spotted Sunfish
Crappie
Channel Catfish

STUDENT COMMENT NO. 23: Jetport Controversy - A Simulation

SITUATION:

An open public hearing is taking place before an "Intergovernmental Review Team" for the purpose of hearing arguments for and against the construction of a Jetport in the Everglades.

ROLES:

Students will play the following roles:

A. Members of Review Team - a representative from each of these:
   1. The Governor of Florida
   2. The Federal Aviation Administration
   3. The Board of County Commissioners of Dade County, Fla.
   4. The Secretary of Transportation
   5. The Secretary of Interior

B. Pro-Jetport Witnesses
   1. Wildlife Biologist (witness on the effect it would have on the biotic communities/wildlife)
   2. Engineer (witness on the effect it would have on the land surface)
   3. Environmental Engineer (witness on the effect it would have on air quality)
   4. Environmental Engineer (witness on the effect it will have on water resources)
   5. Sanitation Engineer (witness on the matter of disposal of solid waste)
   6. Engineer (witness on the displacement of people which might be a result of the Jetport)
   7. Representative of U. S. Department of Transportation (witness on noise impact)

8. Doctor from Dade County Health Department (witness on public health impact)
9. Engineer (witness on flood control)
10. Representative of the U. S. Department of Interior (witness on historical value)
11. Economist (witness on economic impact)
12. Engineer (witness on construction and impact of highways)
13. Representative of the Federal Aviation Administration (witness on aviation needs today and in the future)

C. Anti-Jetport Witnesses

1. An Environmental lawyer representing the "Friends of the Everglades".
2. Anyone from the general public who wished to speak in opposition to the jetport.

PROCEDURES:

The chairman of the review team will call the hearing to order and explain the purpose of the hearing. He will then call for witnesses who wish to present arguments for the construction of the Jetport. He will then call for witnesses who wish to present arguments against the Jetport. After all formal witnesses have been heard, the chairman will invite discussion and questions from the general audience. After all discussion is completed, the Review Team will vote on whether to proceed with the building of the Jetport. Once the vote is completed and announced, the meeting will be adjourned.

STUDENT COMMENT NO. 24: "Selection of Location for the South Florida Regional Airport"

Extensive planning went into the selection of the site for the new South Florida Regional Airport. The original plan called for implementation of the project in four consecutive steps:

1. Approval of the site location for a new major airport in the South Florida area.
2. Acquisition of the proposed site.
3. Construction of a single training runway and taxiway on the proposed site.
4. Ultimate development for air carrier operations, if and when the need develops.[1]

Thus far the first three stages have been completed. The fourth, for the time being at least, has not.

A comprehensive study was conducted as provided in the terms of the Everglades Jetport Pact signed January 16, 1970 by the Federal government, the State of Florida, and Dade County. In essence, the Pact directed Dade County to locate and acquire a suitable site for a new airport and develop sufficient facilities there to transfer its training facilities from the Dade-Collier airport west of Miami. Funding was to be provided from a state and federal level.

The "battle plan" in the comprehensive study was to consider a relatively large number of sites at first, and then progressively reduce the number under consideration while increasing the depth of investigation. It was expected that this method would achieve the highest quality of planning from the funds and time provided. The plan called for a Review Team consisting of representatives from five agencies or offices: 1) the Governor of Florida, 2) the Federal Aviation Administration (FAA), 3) the Board of County Commissioners of Dade County, Florida, 4) the Secretary of Transportation and 5) the Secretary of the Interior.

The function of the Review Team was to approve and administer the conduct of the Study, decide as to the initial sites to be studied, decide at appropriate times during the study as to elimination of particular sites from further consideration, make the final decision as to the site to be recommended, and conduct

public hearings on the recommended site.[2] To perform the detailed studies and draft the reports the Review Team needed to make its decisions, a large Study Team of 40 specialists was assembled. These experts drew up 72 reports providing in-depth analyses in the following 24 areas:

| | |
|---|---|
| Ecology | Matrix Analysis |
| Public Health | Airport Design |
| Waste Disposal | Noise Forecasts |
| Airspace | Bonding |
| Airport Engineering | Economics |
| Urban Planning | Financial Feasibility |
| Highway Engineering | Noise Impact |
| Law | Institutional Considerations |
| Hydrology | Technology Forecasts |
| Demand Forecasts | South Florida Ecology |
| Mass Transit | Traffic Forecasts |
| Community Response | Architecture[3] |

Input was also provided from the FAA, the Department of the Interior, and the Department of Transportation.

In addition to the extensive studies conducted, the airport planners sought maximal community participation. In the spirit of the Florida "Sunshine Law" which requires state or local officials to discuss public business only when their discussion is open to news media, the Review Team opened up all its meetings and records to the media, from the beginning to the end of the investigation. Media coverage was thorough. Another means of keeping the public informed was public hearings, timed to precede key Review Team decisions. At such hearings, the floor was opened to the public for statements and questions, both prepared and extemporaneous. At no point was information concealed, and every effort was made to make the office of the Study Coordinator (Norman W. Arnold of Howard, Needles, Tammen and Bergendoff) available to anyone seeking information. Every citizen's comment or complaint received a reply. Hundreds of meetings were held with scores of community organizations and many other agencies. In short, every effort was made to achieve as broad a base of public involvement as possible in the determination of a location for the South

Florida Regional Airport.

-- Dade County Port Authority, South Florida Regional Airport Site Selection Study Program, Preliminary Environmental Impact Statement, Oct. 1972, "Introduction," pp. 7-9.

otes:

[1] p. 7
[2] p. 7
[3] p. 8

STUDENT COMMENT NO. 25: "Projected Impact of a South Florida Regional Airport"

> "The effects upon the South Florida ecosystem as a whole will be minimal. Little or no impact on populations or rare or endangered species will occur."[1]

This statement, taken from the Dade County Port Authority's Preliminary Environmental Impact Statement on the proposed Everglades jetport, fairly well sums up the conclusions of the study in most areas relating to the environment. Although the statement acknowledges potential problems in some areas in general the evidence presented therein points favorably toward construction of the airport in a 31,000 acre tract of land west of Miami, at the eastern fringe of the Everglades. The report analyzed many different aspects of the potential environmental impact of the jetport. A summary of its findings follows:

Effect on Wildlife: Although most wildlife will flee the area during construction, adjacent land will provide alternative habitats. Reseeding will create new meadow-like biotic communities. Few species, if any, will be affected in the surrounding region.

Land Usage: About 9,000 acres will be cleared of 15-30 million cubic yards of peat. A third of the peat will be retained for landscaping. Much vegetation will be cleared. Excavation will create 1.2 square miles of open water. Erosion will occur only during actual construction.

Air Pollution: Air pollution will be limited to a 4-mile radius of the center of the runway system. Pollution from automobile exhaust will occur only within a few blocks of the terminal. Pollution from an on-site refuse incinerator will be insignificant. There will be no serious contamination of the region around the jetport.

Water Pollution: Only the water system within the airport site itself will be disrupted. Drainage to the Everglades will not suffer any substantial interruption. Advanced water treatment will keep waste water

from the airport facilities at acceptable levels.

Solid Wastes: A high-performance incinerator like those used for municipal wastes will be adequate to handle airport refuse while complying with local regulations on air quality.

Displacement of Persons: Two private homes, 65 mobile homes, a public park, a fishing camp and two radio facilities will be affected. A local airport nearby will be closed to assure necessary airspace.

Land Development: Good zoning will be essential to control urban growth, since there will be much economic pressure for both commercial and residential development in areas surrounding the new airport.

Noise Pollution: The level of noise pollution will be low compared to that at existing airports in the Miami area, and confined mostly to the jetport site itself. Advanced technology will limit noise both in the aircraft and in a rapid transit system on the ground.

Public Health: The chief threat is disease-carrying insects from nearby swamps, but proper controls should minimize health hazards.

Flood Control: Since less than 30% of the 31,000 acre site will actually be affected by construction, substitute land from adjacent regions will be fully adequate to assure flood control.

Economics: Since development of the airport will stimulate the economy of the area, both the airport and airport access could probably be financed by revenue bonds.

Traffic: If existing plans for a highway system are implemented and new airport access routes constructed, the overall impact on traffic in the region will be minimal.

Effect on Other Airports: Operations at Miami International will be phased down to one runway by 1990; Opa Locka Airport closed entirely, and lesser restrictions imposed on air traffic at North Perry and Fort Lauderdale International Airports.

The study concluded by considering alternatives to the Everglades jetport, which was chosen from 36 sites originally investigated. Three major possibilities existed: 1) taking no action, and later developing

Dade-Collier Airport, 2) taking limited action and continuing training operations at Dade-Collier, and 3) making adjustments in the design and boundaries of the Everglades facility.

-- Dade County Port Authority, South Florida Regional Airport Site Selection Study Program, Preliminary Environmental Impact Statement, Oct., 1972, "Summary," pp. 3-4.

STUDENT COMMENT NO. 26: Population Growth and Air Travel

Population Growth in Selected Florida Counties

| YEAR | DADE | BROWARD | PALM BEACH | TOTAL |
|---|---|---|---|---|
| 1920 | 75,000 | 12,000 | 25,000 | 112,000 |
| 1930 | 150,000 | 35,000 | 50,000 | 235,000 |
| 1940 | 280,000 | 50,000 | 90,000 | 420,000 |
| 1950 | 500,000 | 100,000 | 125,000 | 725,000 |
| 1960 | 950,000 | 325,000 | 225,000 | 1,500,000 |
| 1970 | 1,225,000 | 600,000 | 325,000 | 2,150,000 |

-- US Geological Survey, 1972

Passenger Service - Miami International Airport

| YEARS | MILLIONS OF PASSENGERS SERVED |
|---|---|
| 1961-62 | 4.2 |
| 1962-63 | 4.4 |
| 1963-64 | 5.0 |
| 1964-65 | 5.9 |
| 1965-66 | 6.9 |
| 1966-67 | 8.4 |
| 1967-68 | 9.8 |
| 1968-69 | 10.5 |
| 1969-70 | 10.9 |
| 1970-71 | 11.8 |

-- 1971 Annual Report of the Dade County Port Authority

STUDENT COMMENT NO. 27: Anti-Jetport

The state of Florida has been considering a "Big Cypress Swamp Jetport" which would jeopardize the the existence of much of the plant and animal life in the park. The intervening force this time has been Victor John Yannacone, Jr., a New York lawyer renowned as a defender of the environment. Yannacone filed a class action lawsuit on behalf of all those entitled to the full benefit, use, and enjoyment of the Everglades National Park, including not only this generation of American citizens, but generations unborn. He served a 58-page complaint against the promoters of the jetport. Co-defendants in the case were John A. Volpe, Secretary of Transportation of the United States of America and the Dade County, Florida Board of County Commissioners, Acting as Dade County Port Authority. One environmentalist lawyer against the combined forces of local, state and federal government -- hardly a match?

Or was it?

Yannacone's strategy was essentially the same as that of the Environmental Defense Fund in the Cross-Florida Barge Canal case, except that it placed even greater emphasis on a scientific study of the projected damages the jetport would cause to the environment. Yannacone's class action was also based on the alleged violation of the 5th, 9th and 14th amendments of all those who wished to enjoy the unspoiled natural resources of the Everglades.

Yannacone traced eight specific hazards to the environment which he claimed would be caused directly or indirectly by the construction of the "Big Cypress Swamp Jet Port":

1. Water pollution. The drainage and canalization of the area--essential to the construction of the airport--would radically alter the water system of the entire region and upset the balance of the Everglades ecosystem. Another form of water pollution is the possibility of eutrophication, a technical term for the widespread growth of algae which can be caused by the discharge of wastes

containing phosphates into natural waterways. Such wastes would inevitably accompany the large-scale construction projects required for the jetport.

2. Pesticide contamination. The quantities of DDT found in chemical analysis of the eggs of certain Everglades birds is already just under the danger level as a result of contamination from the present usage of the pesticide in Dade County. A new urban concentration around the proposed jetport would require extensive use of pesticides to control mosquitoes from nearby swamps. As a result, increased DDT contamination would most likely threaten numerous species of wildlife in the Everglades.
3. Air pollution. The fallout of jet exhaust during landings and take-offs would be certain to have an adverse effect on the presently pure atmosphere about the swamps, and would also be dissolved into the natural waterways below. Furthermore, there would be appreciatle air pollution from exhaust fumes of the automobiles which could be expected to jam the new superhighways linking the jetport with the Metropolitan Miami area.
4. Danger of extinction for some species of wildlife. Numerous species of wildlife which are already on the list of rare and endangered species could be pushed into extinction by the spoilage of their natural breeding grounds. Among those threatened are 12 species of birds (Yannacone listed them), especially the extremely rare Cape Sable sparrow and the wood ibis; four species of mammals (the Mango fox, squirrel, manatee and Everglades mink), and the rare and endangered American Alligator. In addition, the area is known to contain 15 to 20 species of amphibians and 55 to 60 species of reptiles, all performing vital roles in the food chain of the ecosystem. Rare tropical plants would also be threatened by side effects from the jetport, including species of tropical plants such as orchids and ferns which are found nowhere else in the United States.
5. Noise pollution. The constant noise along the jet corridor would disrupt the wilderness along

the northern part of the Everglades National Park and even more so in the Big Cypress Swamp to the north.

6. Disturbing Indian Tribes. The Miccosukee Indians would be suddenly subjected to 24-hour noise bombardment by powers utterly beyond their control.
7. Bird strikes. Large flocks of birds, especially large water birds, would pose a significant aviation hazard, from ground level to 2,000 feet. The presence of small animals on the runways during flood periods would aggravate the problem because they would be crushed by airplanes and attract carrion-eating birds.
8. Fire and smoke. The combination of bird strikes, pest insects from swamps and small animals seeking refuge from high water on the runways would doubtless prompt authorities to drain much of the jetport area, and property development around the jetport would cause other large expanses of land to be drained. This, in turn, would greatly increase the risk of fires and permanently destroy the ecological balance of the entire south Florida region.

Yannacone concluded by arguing that the negative effects of the jetport would be irreparable. Since no damages paid after the fact could restore the ecology of the region, the only alternative would be to prohibit its development.

STUDENT COMMENT NO. 28: "Meanwhile, Back in the Glades..."

A few years ago there was a tremendous controversy over the planned development of a huge futuristic jetport west of Miami in the Everglades. Municipal authorities argued that a new facility was essential to take pressure off overcrowded airports in the Miami area. Conservationists contended that the heavy air traffic and side effects of fuel dumps, hotels, restaurants and highway traffic to and from the jetport would cause irreparable damage to the delicate ecology of this unique area. The battle ended up in court, and the conservationists won. The jetport was dead.

Or was it?

While the attention of Florida conservationists have been turned elsewhere to new and urgent campaigns, an interesting development has been taking place in the Everglades. The "un-jetport" has not exactly been returned to the bottom desk drawer in an architect's office. What many don't realize is that a two-mile concrete runway and a control tower had already been completed before work on the jetport was halted. In the original agreement of January 16, 1970, known as the "Jetport Pact," it was specified by the co-signing Dade County, federal and state officials that the existing $13-million runway and tower could be used as a training ground as long as it had no ill effects on the wildlife in the area.

This is exactly what has happened, to the tune of nearly 100,000 landings and take-offs from the unfinished airport in 1972 alone. Commercial, military and private pilots use the 34-square-mile Everglades airstrip as a training field. The bulk of the traffic consists of practice flights by Eastern and National Airlines. There is approximately one take-off or landing per minute, round the clock, weather permitting.

MIAMI INTERNATIONAL OVERCROWDED

The reason for using the Everglades facility for training flights was primarily to reduce traffic at Miami International Airport. This has been successful; take-offs and landings at Miami International dropped

off from 490,000 in 1969 to 280,000 in 1972. Most of the difference was directly attributable to the transfer of practice maneuvers to the Everglades site. The director of the Dade County Port Authority, Richard Judy, indicated that the re-distribution of air traffic lessened the risk of a crash in the populated Miami Metropolitan area. He also stated that the Port Authority had collected approximately $900,000 during the 1971-72 fiscal year from 32 airlines which have used the practice facility.

The use of the Everglades runway as a training field, then, has unquestionable advantages. The key questions which remain are: Does the present use of the airport pose a threat to the environment? and Will continued use pose such a threat?

Opinion is divided on these issues. Jim Ashlock, public relations man for Eastern Airlines, claims the effects of the present program on the environment are negligible. "Our flights only make touch-and-go landings in the Everglades and return to Miami International," he explained. "Just flying airplanes in and out has no impact on the environment. Environmentalists have been concerned with the impact of support facilities employing 10,000 or more people out there as once planned."[1]

Conservationist Lyman Rogers disagrees. He said that the pollution from one large jet taking off was equivalent to 2,000 automobiles operating eight hours a day.[2] And Bill Partington, director of the Environmental Information Center in Winter Park, said the current level of training in the Everglades "...must have a detrimental effect. The effects of the air pollutants on the watershed are subtle and they have a tendency to magnify as they go through the ecological chain," he warned. "Such things are never accurately anticipated, but one day you'll wind up with fish on your plate that has gunk from an airplane."[3]

## ENVIRONMENTAL WATCHDOGS

The only way to resolve the controversy is through direct scientific observation. That is precisely what the Federal Environmental Protection Agency has set out to do. Beneath the control tower at the Everglades airport is a trailer loaded with sophisticated equipment to measure air pollution, installed by the EPA

last March. Water pollution samples have been taken periodically for the past two years. Noise pollution equipment was installed December 17, 1972.

The results so far have been inconclusive. The data from the recently-installed noise pollution equipment has not yet been analyzed. John T. Brown, coordinator of the South Florida Environmental Project for the U.S. Department of the Interior and supervisor of the pollution-monitoring program at the airstrip, pointed out that "...the sound of an airplane is not distinguishable from the bellowing of an alligator in mating season."[4] Water pollution samples have not yet discovered any negative effects on the swamplands. The only area with a positive result thus far has been air pollution; there have been high readings on occasions. The only specific pollutant to exceed federal standards has been ozone, but this is the key element in the corrosive smog which plagues Los Angeles. The EPA will continue to monitor pollution levels in the Everglades in an attempt to gather more precise evidence concerning the effects of the airplane training program on the environment. In the mean time, egrets and other wading birds have taken up residence in a mudhole right behind the pollution-control trailer, apparently undaunted by the antics of their metallic counterparts. Alligators, wild hogs and deer occasionally work up the nerve to venture across the asphalt and concrete. There has been no immediately apparent impact on the environment.

## FUTURE PLANS OUTLINED

What is the future of the Everglades airstrip? The ruling against its further development appears firm, but the use of the runway as a training strip is apt to continue. The 1970 pact expired in January, 1973, but renewal was expected, as both the Federal Departments of the Interior and Transportation and Dade County officials favored renewal. "Renewal of the pact is not really contingent upon these pollution results," Brown explained. "But if there is harm to the environment, if an adverse impact can be shown, a shutdown of the training facility may be sought and the operations stopped."[5] Walter Revell, secretary of the Florida Department of Transportation, said the Everglades site probably would remain in use until runways at a new site

were in operation some time between 1977 and 1982.[6] Some airline officials indicated that the training field would be utilized even past those dates, due to ever-increasing air traffic at crowded urban areas.

One positive factor for the environment at present is the fact that much of the present air traffic at the training field is comprised of Eastern's new Lockheed L1011 jet, a wide-body liner capable of transporting 226 passengers, and National's DC 10. Both, according to airline spokesmen, have the latest emission control devices on them to minimize the danger to the environment.

On the other side of the coin, the development of such new aircraft means that many domestic airlines are contracting their older planes to foreign carriers, whose pilots train at the Everglades practice field. These aircraft, of course, do not have advanced emission controls.

The future of the Everglades airport, then, is uncertain. It is undoubtedly serving an important function to the airlines. So far this function has apparently been served WITHOUT major damage to the environment. Scientific observation will continue, to make sure this remains true. Is it possible, as some conservationists fear, that the Everglades have already suffered damage which will not be revealed until it progresses further along the ecological chain?

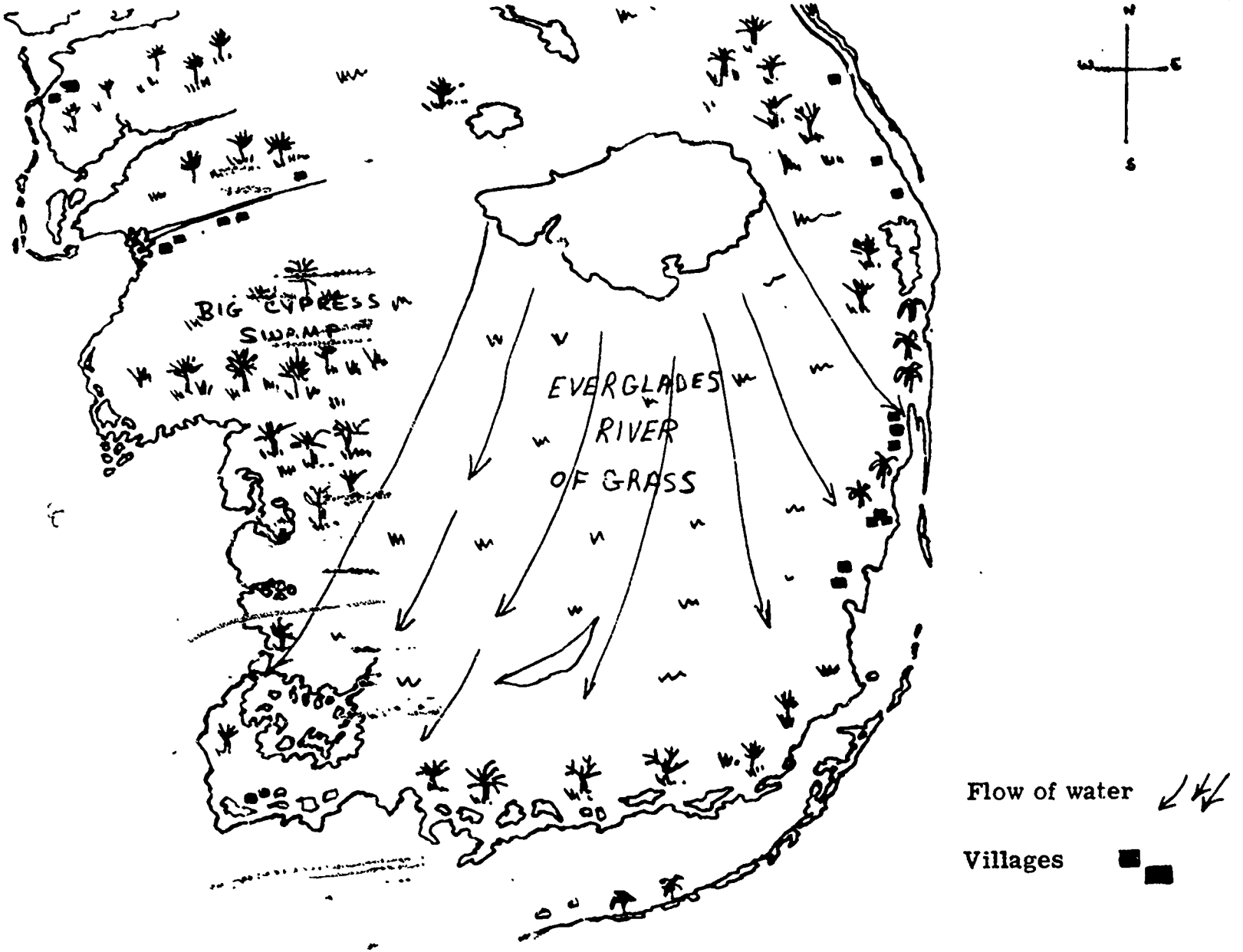
Only time will tell.

-- Tatro, Nick, "The Jetport That Isn't," TODAY Newspaper, Jan. 14, 1973, p. 1E and 6E.

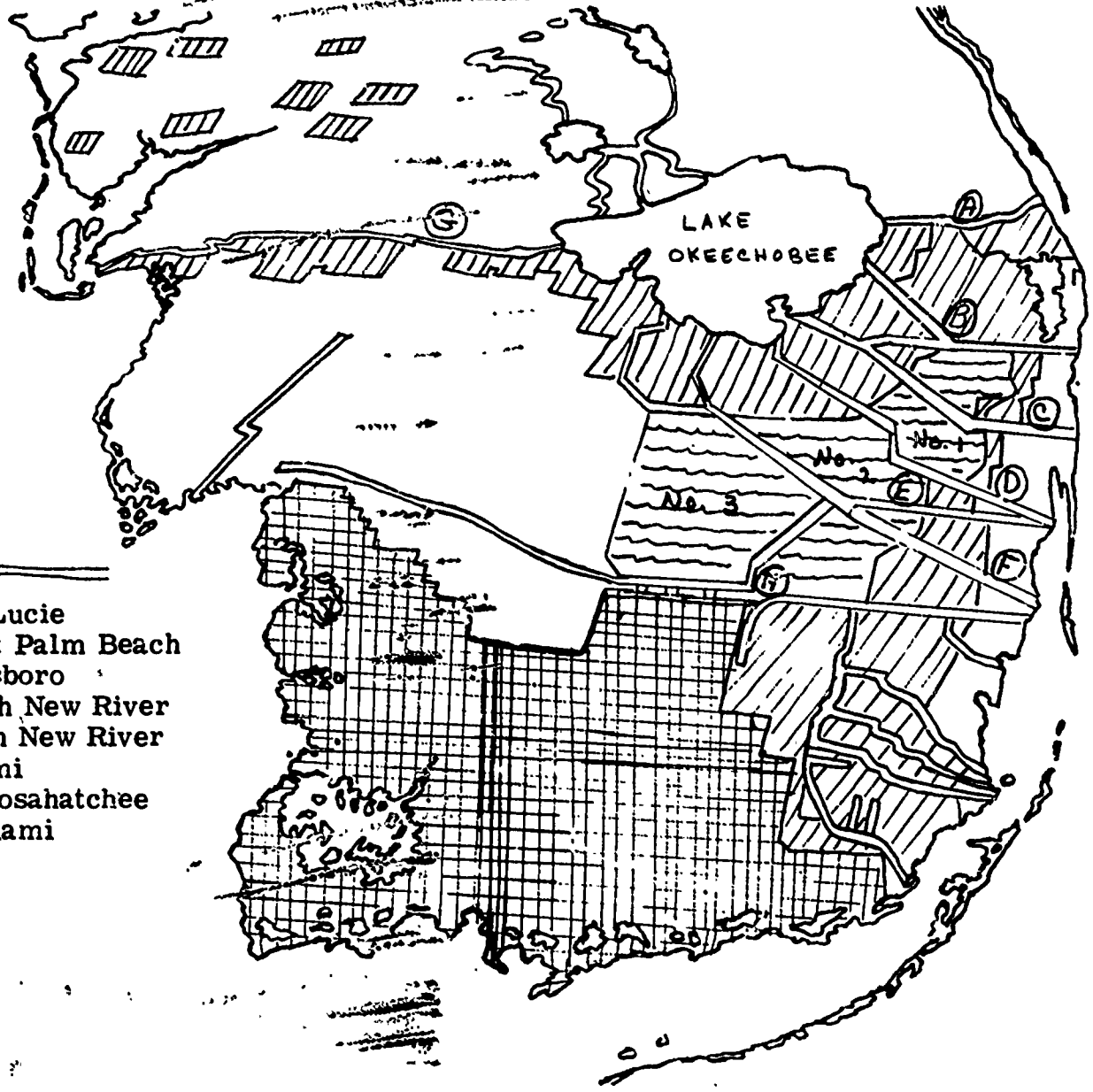
Notes

[1] p. 6E
[2] p. 6E
[3] p. 6E
[4] p. 1E
[5] p. 1E
[6] p. 1E

STUDENT COMMENT NO. 3 1871 Map of Everglades



STUDENT C[illegible]MMENT NO. [illegible] South Florida's National Park, Conservation Areas, Agricultural Zones, and [illegible]





Canals:

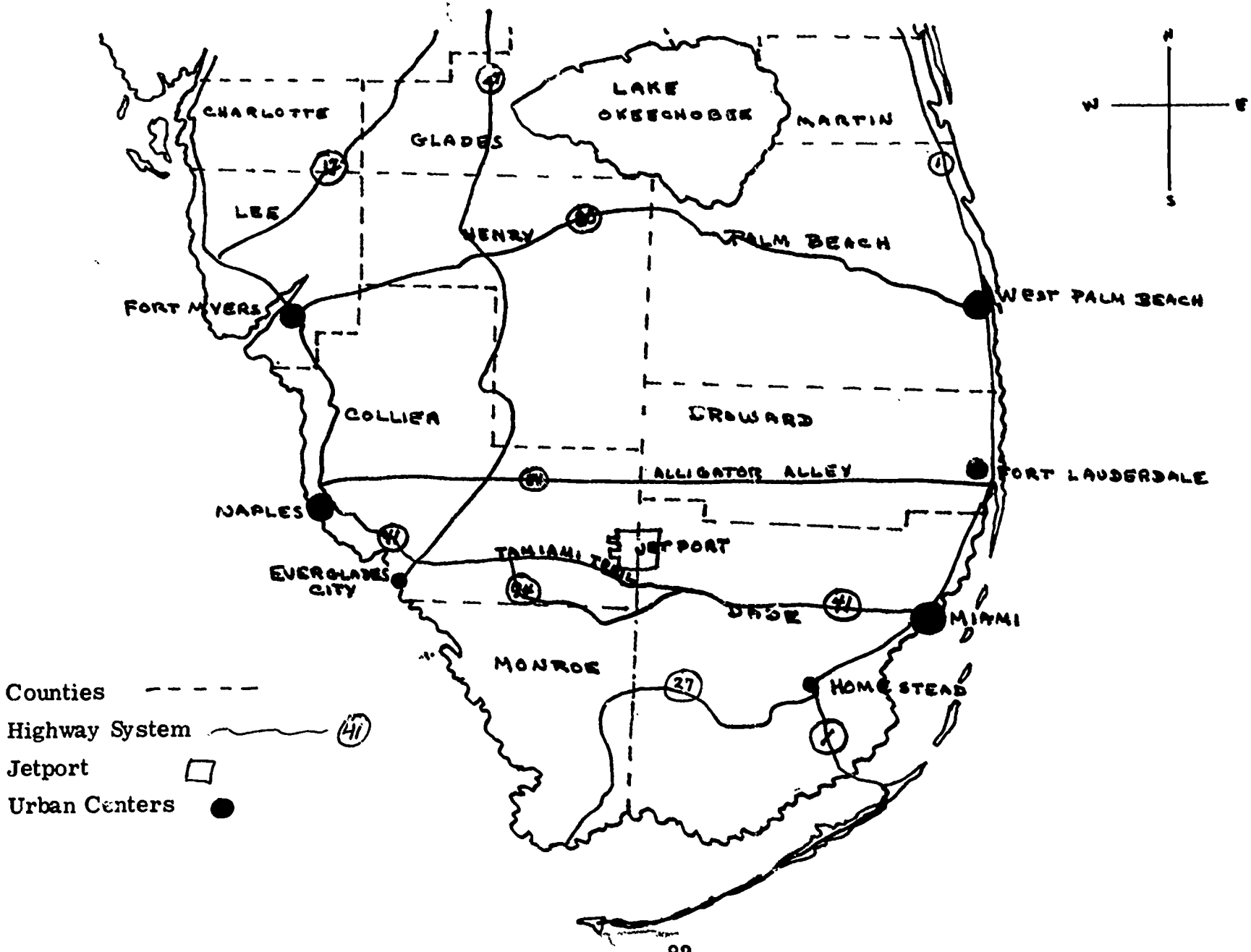
A. St. Lucie
B. West Palm Beach
C. Hillsboro
D. North New River
E. South New River
F. Miami
G. Caloosahatchee
H. Tamiami

Everglades National Park

Conservation Areas

Agricultural Zones

STUDENT COMMENT NO. 31: South Florida's Counties, Major Cities, Highway System and Jetport



STUDENT COMMENT NO. 32: Duties for the General Inspection Team

The general inspection team will be responsible for the following:

(1) Seining for aquatic species
(2) Probing inspections for isolated species
(3) Photographing species too large to be collected
(4) Transporting common equipment

STUDENT COMMENT NO. 33: Duties for the Specific Inspection Team

The specific inspection team's responsibilities include: counting, recording, and collecting botanical and zoological organisms as well as conducting abiotic tests. Two students should be assigned to botanical features, one student to the zoological, and two students to the abiotic conditions. Specific information requested for these characteristics is detailed on the following data sheets:

DATA SHEET FOR SPECIFIC INSPECTIONS

Team #_____ Date_____ Time_____

Name and description of collection site_____

_____

Botanical Population Studies

Macroscopic Organisms:

| | Species Name | Number at Site | Average Height Above Ground |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |

Microscopic Organisms:

| | Species Name | Number (amount) at Site |
|---|---|---|
| 1. | | |
| 2. | | |
| 3. | | |
| 4. | | |
| 5. | | |

## Zoological Population Studies

Macroscopic Organisms:

| | Species Name | Number at Site |
|---|---|---|
| 1. | | |
| 2. | | |
| 3. | | |
| 4. | | |
| 5. | | |
| 6. | | |

Microscopic Organisms:

| | Species Name | Number at Site |
|---|---|---|
| 1. | | |
| 2. | | |
| 3. | | |
| 4. | | |
| 5. | | |

Note any indications of animal life

a. Tracks

b. Droppings

ABIOTIC STUDIES

SOIL TEST:

1. Core samples (one in each corner of site and one in the middle)

   a. Depth of cores _____

   b. Color and depth of color change in core
      (1) _____
      (2) _____
      (3) _____

2. Nutrient analysis (package each core for return to lab for inspection)

   a. Nitrogen content _____

   b. Phosphorus content _____

   c. pH _____

   d. Potassium hydroxide (KOH) _____

3. Moisture content of soil _____

4. Water holding capacity of soil _____

WATER TEST:

1. Depth of sample _____

2. DO and BOD samples _____

3. Collect gallon water samples (2) for lab work
   a. Nitrate level _____
   b. Phosphorus level _____
   c. Salinity _____
   d. pH _____

4. Turbidity of water _____

General Studies

GENERAL CONDITIONS:

1. Air temperature in °C _____

2. Water temperature in °C _____

3. Weather conditions
   a. type of sky _____
   b. amount of humidity _____
   c. wind speed and direction _____

GENERAL MEASUREMENTS:

1. Sunlight
   a. at ground level _____
   b. 0.5 meters above _____

c. 1.0 meters above _____
d. 1.5 meters above _____
e. 2.0 meters above _____

2. Temperature
   a. at ground level _____
   b. 0.5 meters above _____
   c. 1.0 meters above _____
   d. 1.5 meters above _____
   e. 2.0 meters above _____

Comments:

STUDENT COMMENT NO. 34: Equipment Needed for Field and Lab Work

Part I - Team Kits

2 centigrade thermometers
2 meter sticks
4 stakes
2 D. O. bottles
1 gallon jug
2 petri dishes
30 tags for marking plants
15 to 20 assorted bottles of formaldehyde
2 data sheets per team
4 or 5 scrap newspapers
1 collecting box

Part II - Common Kit (for use of all)

1 soil cover
1 triangular scoop
1 humidity indicator
1 Secchi disk
1 seine
2 light meters
1 wind indicator
1 camera (probably under the jurisdiction of one student)

Part III - Lab Equipment

1 or more Nitrate, Nitrite kits
1 or more Dissolved Oxygen kits
1 or more salinity test setups (as per investigation)
2 or more plant presses
3 or more dissecting scopes
forceps
1 incubator
1 or more Orthophosphate kit
2 dessicating ovens
3 to 5 new pH paper testers
2 or more Sudbury soil test kits
3 or more microscopes
assorted lab tools
scalpels
a classroom set of texts which includes guides or keys for identifying organisms

Note: Pay special attention to other items that might be needed to facilitate the field trip.

STUDENT COMMENT NO. 37: Soil Nutrient Determination

Locate and use directions from Sudbury Soil test an alternate method is to use test for pH found in BSCS, Green version, page 239 and then modify the same test for determining Potassium hydroxide, Nitrogen, and Phosphorous.

STUDENT COMMENT NO. 38: Moisture Content of Soil

BACKGROUND: Water content is defined as the amount of water in the soil at a particular time. It is important to know the amount of water in a soil that is available to the plant. In order to find out what is available we can measure the moisture content.

PURPOSE: To measure moisture content in the soil.

MATERIALS:

100 gram soil sample
Filter paper
Aluminum soda can

PROCEDURE:

1. Weigh a dry, empty aluminum can. Record weight _____
2. Collect soil sample and weigh in the aluminum can. Record the weight _____
3. Dry soil by using a Bunsen burner. Heat the soil for several minutes over an hour's time. Do this for two days. Cover the can overnight so that no moisture will get into it. (If drying oven is available, place soil in oven for 24 hours.) Record weight _____
4. Weigh the soil after 48 hours. Record weight _____ The weight loss will be the water loss.
5. Subtract the weight of the 48 hour sample from the original sample. (#2 - #4) (Example 60 g of soil before drying; after 48 hours, the soil weighed 50 g, then the total weight of water sample is 60 - 50, or 10 g.

6. Calculate the percent moisture by using the formula:

$$\% \text{ moisture} = \frac{\text{Loss of weight due to drying}}{\text{Weight of dried soil}} \times 100$$

STUDENT COMMENT NO. 39: Water-holding Capacity of Soil

PURPOSE: To measure water-holding capacity of the soil.

MATERIALS:

Dried soil from the moisture content experiment
Aluminum can
Graduated cylinder
(100 grams of dried soil if other soil is not available)

PROCEDURE:

1. Put a small hole in the bottom of the aluminum can. Now place 100 g of soil in the aluminum can.
2. Place can in a pan or beaker of water overnight to maintain moisture.
3. The next day raise aluminum can out of water and place a piece of filter paper on the bottom.

Allow to drain 30 minutes.

4. Wipe the surface dry and weigh the unit.
5. Moisture-holding capacity is calculated as follows:

$$\text{Per cent moisture-holding capacity} = \frac{\text{Gain in weight after immersion in water}}{\text{Weight of dried soil prior to immersion in water}} \times 100$$

NOTE: The gain is computed by subtracting the combined weight of the can and dry soil from that of the can and wet soil.

OPTIONAL: Acidity and alkalinity can be tested by placing a drop of distilled water on a sample of dried soil. Use litmus paper to check acid or alkaline conditions of soils.

STUDENT COMMENT NO. 40: Biochemical Oxygen Demand

BACKGROUND: A high Biochemical Oxygen Demand (BOD) indicates that a great amount of oxygen is needed for bacteria and mold for the decomposition of a large amount of dissolved organic material. If the BOD is very high, the available amount of dissolved oxygen is utilized for decomposition and there is little left for larger animal and plant life. A BOD test can be affected by temperature, agitation, etc., but it gives a good estimate of the amount of decomposing activity that a body of water must support.

To perform the test collect samples in glass pint jars obtained from home or in 250 ml glass-stoppered bottles from the laboratory. However, all containers should be clean and similar in size. Locate collection points on a stream or lake. At each point rinse a collecting bottle several times in the water to be sampled. Then fill the jar to overflowing, cap it or stop it under water so that when the bottle is tipped, no free air bubbles can be seen.

Another procedure that may be necessary is to filter those samples which have visible algae or crustacean life within. Since BOD is essentially a measure of microscopic bacterial decomposition process, larger organisms in some samples may affect testing conditions and results. Thus, filter the sample through paper toweling or cloth as it is collected to remove the visible organism.

At the same time samples are collected, you should test for dissolved oxygen at the same sample site and record the results. Use the Hach DO test kit listed below.

The closed bottles should be identified according to test site designation and allowed to sit undisturbed in the dark at constant temperature for five consecutive days.

During this period, bacteria in the water will use up oxygen in the process of decomposing organic material in the water. The amount of oxygen consumed is then a measure of the amount of organic material in the water.

At the end of five days a second dissolved oxygen test should be completed for each sample bottle, and compared with the initial results. Subtract the ppm of oxygen found in the second BOD test from the first test made at the collecting site.

The difference in amount of dissolved oxygen will be a measure of the BOD and will indicate the amount of organic decomposition occurring in the water.

PURPOSE: To determine the quality of natural waters with respect to its $O_2$ requirement of organic decomposition.

MATERIALS: Those materials contained in Hach Kit Model OX-2P

PROCEDURE:

A. High Range (1 drop = ppm DO)

1. Fill the glass stoppered DO bottle with the water to be treated by allowing the water to overflow the bottle for 2 or 3 minutes. Be certain there are no air bubbles present in the bottle.

2. Add the contents of one pillow each of Dissolved Oxygen 1 Powder (Manganous Sulfate) and Dissolved Oxygen 11 Powder (Alkaline Iodide-Azide). Stopper the bottle carefully so that air is not trapped in the bottle. See Note A. Grip the bottle and stopper firmly and shake vigorously to mix. See Note B. A flocculant precipitate will be formed. If oxygen is present the precipitate will be brownish orange in color.

3. Allow the sample to stand until the floc has settled halfway, see Note E, and leaves the upper half of the bottle clear. Then again shake the bottle and again let it stand until the upper half of the bottle is clear.

4. Remove the stopper and add the contents of one pillow of Dissolved Oxygen 111 Powder (dry acid). Carefully re-stopper and shake to mix. The floc will dissolve and a yellow color will develop if oxygen was present. This is the prepared sample.

5. Fill the plastic measuring tube level full with prepared sample and pour it into the mixing bottle.

6. While swirling the sample to mix, add PAO dropwise, counting each drop, until the sample changes from yellow to colorless. The dropper must be held in a vertical manner. Each drop is equal to 1 ppm Dissolved Oxygen.

7. Repeat this procedure on the same sample after having stored in the dark for 5 days.

8. BOD = first $O_2$ ppm minus 2nd $O_2$ ppm

B. Low Range (1 drop = 0.2 ppm DO)

If the result from step 6 is very low, such as 3 ppm or less, it is advisable to test a larger sample so as to obtain a more sensitive test This may be done by titrating directly in the DO sample bottle as follows:

7. Using the prepared sample left over from step 4 above, pour off the contents of the DO bottle until the level just reaches the mark on the bottle.

8. PAO dropwise, counting each drop, until the sample changes from yellow to colorless. Each drop of PAO added is equal to 0.2 ppm Dissolved Oxygen in the sample.

NOTES:

A. It is a bit tricky to stopper the DO bottle without getting an air bubble trapped in the bottle. To avoid the air bubble, incline the DO bottle slightly, and insert the stopper with a quick thrust. This will force air bubbles out. If air bubbles are trapped in the DO bottle in steps 2 or 4, the sample should be discarded and the test started over.

B. A small amount of powdered reagent may remain stuck to the bottom of the DO bottle at this point, but this will not affect the test.

C. Do not allow the PAO solution to stand in direct sunlight, as it is decomposed by ultraviolet radiation.

D. If DO is to be determined in sewage, pretreatment with Copper Sulfate-Sulfamic Acid is required. Write for instructions. The following items are necessary for this treatment:

1949-00 Cylinder, graduated, 500 ml -- each 7.95
357-13 Copper Sulfate-Sulfamic Acid -- 4 oz DB 1.40
1864-99 Siphon -- each 2.00

Above items also come in a DO in Sewage Test Kit, Model OX-13, Cat. No. 2380-00, each $38.95.

E. In samples that contain high concentrations of chloride such as seawater, this floc will not settle. However, no interference is observed as long as the sample is allowed to stand in contact with the floc for 4 or 5 minutes.

STUDENT COMMENT NO. 41: Nitrates and Phosphates (Hach Methods)

BACKGROUND: Plants, fish, water, rocks, silt and solid wastes are all easily recognized in natural waters. Chemicals, however creep in unnoticed if they are colorless and odorless. The presence and source of chemicals can be detected by testing the water. Possible sources and effects of several chemicals found in water are listed in Table 1.

Table 1

Possible Sources and Effects of Several Chemicals Found in Water

| Chemical | Possible sources | Effect of excess | Standard natural concentration at site |
|---|---|---|---|
| Ammonia Nitrogen | Decomposition of organic matter<br>Fish urine | Increases bacterial growth<br>Reduces growth of fish<br>Increases oxygen consumption of fish | |
| Nitrate | Fertilizers<br>Decomposition of organic matter<br>Industrial acids | Increase growth of algae and higher plants<br>Possible cause of "blue babies" in certain concentrations | |
| Phosphate | Fertilizers<br>Household detergents<br>Organic matter | Increases algal growth | |

Phosphates and nitrates are normal components of all natural waters. Moderate quantities of these compounds are required for the normal growth of aquatic plants, terrestrial plants, and algae. Excessive amounts of these chemicals are often found in polluted natural waters resulting in the hypernutrition (eutrophication) of the algae or aquatic plants. This overfeeding, or fertilization, usually results in increased plant growth, an algae "bloom" or a weed choked body of water. Since most organisms utilize oxygen for respiration, the overgrowth of weeds or algae will compete with fish for oxygen often resulting in a massive fish kill. Eutrophication often results in the "death" of the body of water filling it with dead aquatic plants and killing its aquatic animal life. See the text and study the nitrogen cycle for a thorough understanding of the role of nitrogen in the ecosystem.

Bacteria can convert nitrogen as follows:

Organic Nitrogen → decay → Ammonia → Nitrite bacteria → Nitrite → Nitrate bacteria → Nitrate

PURPOSE: To learn how to determine the amount of nitrate, nitrite, and ortho phosphate in water for the purpose of making such tests on samples collected at school or home study sites.

MATERIALS:

Hach kit Model N1-10 (Nitrate-Nitrite Test Kit)
Hach kit Model PO-19 (Phosphate Test Kit)

PROCEDURE: Total Nitrate-Nitrite (does not include ammonium or organic nitrogen).

PART 1: Nitrate - Nitrite

1. Fill one of the color viewing tubes about halfway to the lower mark with demineralized water. Stopper and shake vigorously. Empty the tube and repeat the procedure.

2. Fill the pipette by suction to just above the constriction, with the water sample. The tip of the pipette is then wiped clean and the excess liquid allowed to drain, automatically stopping at the constriction. For best results, rinse the pipette several times with the sample. Blow to discharge the sample from the pipette into the rinsed color viewing tube.

3. Fill the color viewing tube to the upper mark (10 ml) with demineralized water.

4. Add the contents of one Vitra Ver IV Powder Pillow, stopper the tube and shake vigorously for one minute. If nitrate and/or nitrite is present, a pink color will develop. Allow an additional 3 minutes for full color development.

5. Insert the tube containing the prepared sample in the right hand opening on top of the color comparator.

6. Fill the second color viewing tube to the lower mark with demineralized water and insert it in the left hand opening of the color comparator.

7. Hold the color comparator up to a light, such as the sky, a window, or a lamp and view through the openings in front. Rotate the color disc until a color match is obtained. Read the ppm Nitrate Nitrogen (N) and/or Nitrite Nitrogen (N) from the scale window. (See Note A.)

Medium Range (o-10 ppm Nitrogen)

1. Same as step 1 above.

2. Rinse the plastic dropper with the sample or with the pretreated sample, then fill to the 1.0 ml mark. Add it to the rinsed color viewing tube.

3-7. Same as steps 3 through 7 above, except that the scale reading is divided by ten to obtain the ppm Nitrate and/or Nitrite Nitrogen (N) in the sample.

Low Range (0-1 ppm Nitrogen)

1. Rinse a clean color viewing tube with some of the water to be tested, then fill it to the upper mark with the water sample. No dilution is required.

2-5. Same as steps 4 through 7 above, except that some original water sample should be used instead of demineralized water in step 6 if there is color and/or turbidity in the water itself and in step 7, the scale reading is divided by one-hundred to obtain the ppm Nitrate and/or Nitrite Nitrogen (N) in the sample.

PART II: Phosphate

High Range (1-50 ppm Orthophosphate)

1. Rinse the plastic dropper several times with the water sample.
2. Fill the dropper to the 0.5 ml mark. Discharge into one of the color viewing tubes, which has been rinsed with demineralized water.
3. Add demineralized water to the 5 ml mark. Swirl to mix.
4. Add the contents of one Phos Ver 111 Powder Pillo for 5 ml sample. Swirl to mix. Allow one minute for color development. If phosphate is present, a blue-violet color will develop.
5. Insert the tube of prepared sample in the right opening on top of the color comparator.
6. Fill the other tube to the 5 ml mark with demineralized water. Insert it in the left opening of the color comparator.
7. Hold the color comparator up to a light such as the sky, a window or a lamp, and view through the two openings in the front. Rotate the color disc until a color match is obtained. Read the ppm phosphate ($PO_4$) from the scale window. (See Note B.)

Low Range (0-5 ppm Orthophosphate)

1. Fill both color viewing tubes to the 5 ml mark with the water sample.
2. To one of the tubes, add the contents of one Phos Ver 111 Powder Pillow for 5 ml sample, and swirl to mix. Allow one minute for color development. If phosphate is present, a blue-violet color will develop.

3. Insert the tube of untreated water sample in the left opening of the color comparator.

4. Hold the color comparator up to a light such as the sky, a window, or a lamp and view through the two openings in the front. Rotate the color disc until a color match is obtained. Divide the reading in the scale window by 10 to obtain the ppm Phosphate ($PO_4$).

NOTES:

A. The color should be compared after one minute but before two minutes.

B. To obtain the value as ppm Phosphorus (P), divide the Phosphate ($PO_4$) value by 3.

REFERENCE:

Hach Chemical Company
Box 907
Ames, Iowa 50010

STUDENT COMMENT NO. 42: The Determination of the Salinity of Sea Water: Titration Method

BACKGROUND:

The laboratory determination of the salinity via precipitation of the silver halides to an end point is a standard method. The "wet chemistry" process involved is titrametric. Although the experimenter may not appreciate the fine points of titration, he can easily detect the color change, measure the titrant used and correctly apply the table furnished.

Students should be made thoroughly aware of the safety problems to be encountered in any exercise wherein chemicals are employed. Silver nitrate spillage must be cleaned, rinsed and dried. Tall burets filled with titrants topple easily. The resulting mess is often wide-spread.

Overflows and spillages over the top of the buret are at eye-level or above. Eyes must be protected at all times (see appropriate Florida law).

Once silver nitrate is prepared, deterioration of the solution begins with exposure to light, evaporation and air borne contamination. Many chemical laboratories are "rich" in HCl, $H_2S$ and $NH_4OH$ ($NH_3$) fumes. These dissolve in the opened silver nitrate to form sediments and ionic materials. Some are interferences to good end point determinations.

The end point mechanism is that silver chloride is quantitatively precipitated before the red colored silver chromate is formed. Clumps of precipitate tend to form "refuges" for the chloride ion and the silver ion to interfere with a sharp determination. These clumps should be reduced by vigorous agitation periodically. The addition of 2 or 3 small plastic beads to the reacting vessel will be helpful to break clumps.

Although the pH of the sample is not made a part of this exercise, good results require a pH of 7 - 10. Adjust samples of pH below 7 with 0.1N NaOH.

The student must be able to read the meniscus in order to correctly do this exercise.

Preparation of the $AgNO_3$ titrant:

Measure 27.25 grams of crystalline $AgNO_3$.

Dissolve the crystals in approximately 0.5L of ion-free water (distilled). Be sure all crystals have completely dissolved. Fill with more ion-free $H_2O$ to the one liter mark.

This solution must be stored in a dark brown bottle. If several bottles are used, the contamination of one will be a lesser problem. Each buret filling requires about 50ml of $AgNC_3$ solution. One liter will fill 20 burets (with care).

Preparation of the $K_2CrO_4$ indicator:

Add 5 grams of $K_2CrO_4$ yellow crystals to 100 ml of distilled $H_2O$.

MATERIALS:

1. 50 ml buret
1. 125 ml Erlenmeyer
$AgNO_3$ titrant solution
$K_2CrO_4$ indicator solution
Phenolphthalein (consult instructor before using)
NaOH (consult instructor before using)
Distilled $H_2O$
2. 50 ml beakers
1. 10 ml pipet

1. Clean glassware and careful operations are essential. Begin by assuming that the table-top has been contaminated with silver nitrate by the previous class. Although $AgNO_3$ is colorless, skin will turn black in sunlight where $AgNO_3$ is present.

Dampen a paper towel with $H_2O$. Wipe work area with the wet towel, then dry. Each should wear his apron throughout the laboratory exercise. Wear safety goggles always while in the laboratory area.

2. Fill the buret with distilled $H_2O$. Drain buret in short spurts. Try to adjust the stopcock so as to deliver drops and a single drop on demand. Now is the time to learn the idiosyncrasies of the stopcock. Be sure it operates without leaking.

The instructor should be informed about an inoperative buret assembly immediately.

3. Pipet 10ml of saline (sea) $H_2O$ into the 125ml flask. Add about 10ml of distilled $H_2O$. Add 2 or 3 plastic beads.

4. Put 4-6 drops of $K_2CrO_4$ into the flask. This is the indicator.

5. Fill a 50ml beaker with $AgNO_3$.

6. Pour about 5 ml of $AgNO_3$ into the buret. Drain into the other 50ml beaker. Pour this into sink.

7. Partially fill the buret with $AgNO_3$. Turn stopcock to fill the top. Continue to fill the buret until there are at least 40ml of $AgNO_3$ within the graduated scale. It is not necessary to fill the buret exactly to "O" or exactly "50" (the top reading). This is time consuming.

8. Record the reading at the start (read Meniscus). The buret either has "50" or "O" or both as the top graduation. In either case, record the start and end graduations. Subtract the smaller from the larger to find the volume of $AgNO_3$ used in milliliters. Most burets can be read to the tenth of ml. Touch the hanging last drop in the buret with the rim of the flask so it will run into the liquid.

10. Agitate the flask. DO NOT LOSE ANY LIQUID--to make sure, use a stopper.

11. Repeat steps 9 and 10 until the first pink-orange color appears.

12. Agitate well. The clumps of precipitate must be reduced to very small particles. The flask contents should return to the original color.

13. Add $AgNO_3$ drop by drop while agitating the flask contents sufficiently to keep the precipitate particles small. When the pink color reappears, "catch" the hanging drop. Stopper. Shake vigorously. If the pink color remains, this is the end point. Otherwise, repeat Step 13.

14. Once the end point is reached calculate the volume of $AgNO_3$ used. (See 8). THIS IS THE SALINITY. However, a correction may need to be applied--consult the table below.

Salinity Corrections (Harvey, 1963)*

| Salinity, S 0/00 found | Correction to be applied | Salinity, S 0/00 found | Correction to be applied |
|---|---|---|---|
| 40 | -0.15 | 22 | +0.22 |
| 38 | -0.08 | 20 | +0.23 |
| 36 | -0.03 | 18 | +0.23 |
| 34 | +0.03 | 16 | +0.23 |
| 32 | +0.07 | 14 | +0.20 |
| 30 | +0.11 | 12 | +0.19 |
| 28 | +0.15 | 10 | +0.16 |
| 26 | +0.17 | 8 | +0.15 |
| 24 | +0.20 | | |

*Reprinted by permission of Cambridge University Press, from the Chemistry and Fertility of Sea Waters, by H. W. Harvey, 1963.

15. Collect salinity results from other teams and make a table showing salinity for all sites.

STUDENT COMMENT NO. 43: Counting and Collecting Instructions

Each specific inspection team is to make their own record of their field site. Following are some directions for completing the record:

1. Stake out the collecting site (Student Comment No. 35, page 90).

2. Begin at one corner of the site and count the different animals/plants that are found. It is not necessary that you know their names, but make sure to distinguish between them.

3. Make a collection of each plant found. Take only one of each plant, tag it, and wrap it in wet newspaper. For large plants take only a small section. If it is flowering try to collect the flowers. Do not place any plants in your mouth as some may be poisonous.

4. Make a collection of animals found, but take only one of each species. Use one jar for each specimen collected. Label each jar. Do not attempt to collect large or harmful species.

5. Place animal/plant specimen into collection box. Be careful not to lose tags or crush plants.

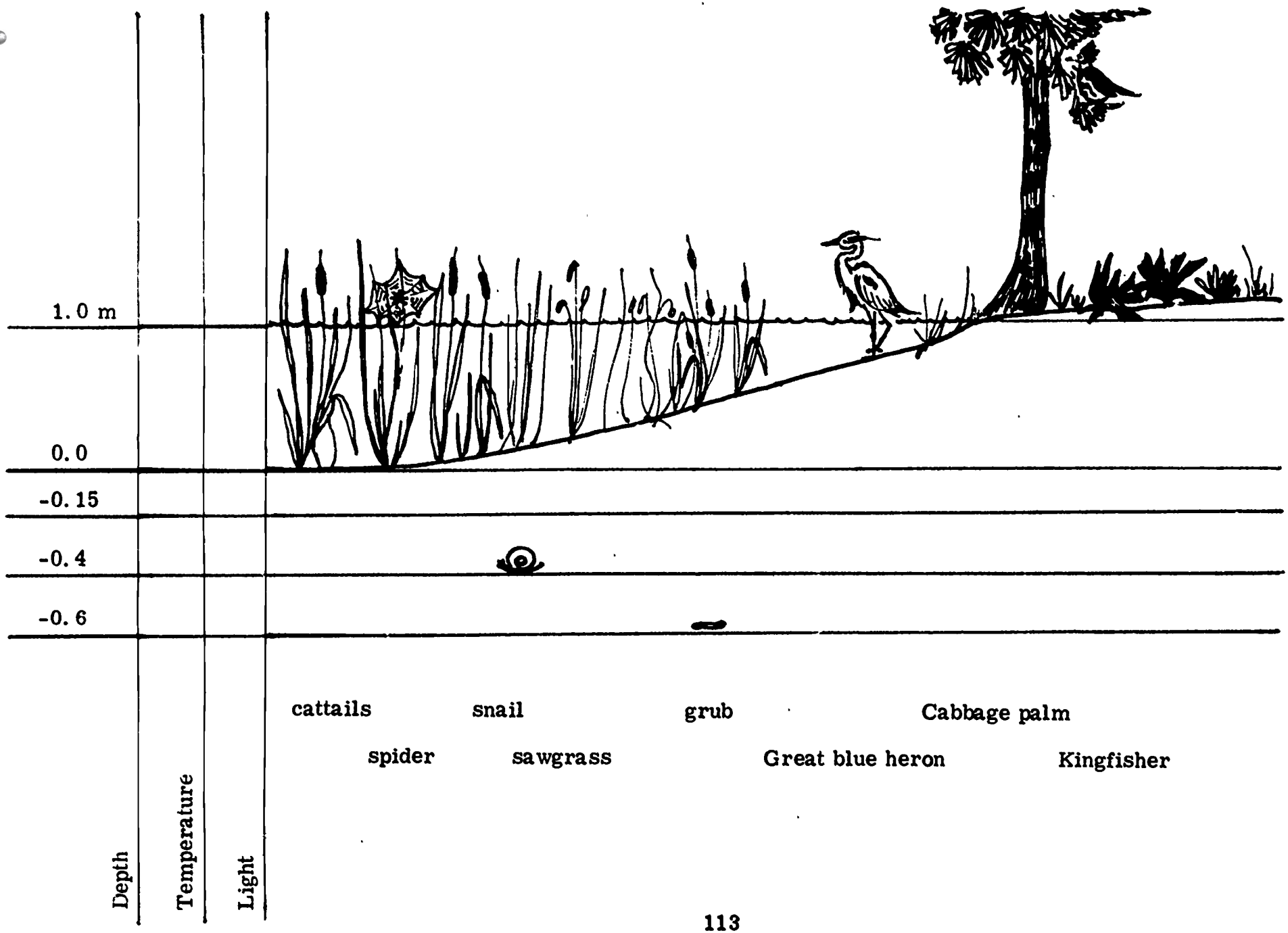
6. Contact general inspection team and request they photograph plants/animals too large to collect.

STUDENT COMMENT NO. 44: Procedures for Making a Vertical Drawing of a Site Investigation

Procedure: Starting at the lowest core level make a scale drawing of the area studied.

1. Show the depth of each layer of soil.
2. Show the depth of water.
3. Show the plants that were found and the heights they were found.
4. If any organisms are found, put them into the drawing at the proper vertical spot (stratification).
5. On the left hand side of drawing show the scale height, changes of temperature at increasing heights, changes of light intensity with increases in height.
6. Along the bottom identify the organisms shown in the drawing.

All measurements should be done in the metric system. The scale drawings should all be done to the same scale so that they can be put together at the completion of the investigation. Follow the example on the next page.


1.0 m
0.0
-0.15
-0.4
-0.6
cattails
spider
snail
sawgrass
grub
Great blue heron
Cabbage palm
Kingfisher
Depth
Temperature
Light

# TEACHER COMMENTS

TEACHER COMMENT NO. 1: Everglades Survival Game

## INTRODUCTION

This game will provide a framework within which the student will investigate the environmental changes which have occurred in the Florida Everglades. It will also provide activities which are designed to make the student aware of the consequences of other types of change which might occur in the Everglades. Because of the various roles they will be playing and the activities they will be engaged in, the student will gain a new awareness of all of the ramifications of environmental change. The student will investigate the history of the Everglades and he will discover the natural and man-made changes which have occurred in this area. The student will become involved in making value judgements in relation to environmental change and he will gain a new awareness of the complexities and conflicts surrounding many environmental changes. The game will end with the students arriving at answers for the eight inquiry questions found on page 123.

## OVERVIEW

### Role Playing

All students will assume an identity by drawing from a box or hat. A list of permanent identities needed for purposes of the pressure cards is given on page 123, however, additional identities may be assigned for specific activities as called for in the directions for that activity. Class leadership will be provided by a student playing the role of the Governor of the State of Florida, a Lt. Governor, and a Secretary for the Governor. The duties of the class leadership are found on page 122.

### Evaluation

Students will earn ESPs (Everglades Survival Points) for all activities they participate in. Points

may be awarded for research, oral presentations, role playing activities, tests, or any other constructive activities associated with developing a better understanding of the issues surrounding the survival of the Everglades. At times the students may lose ESPs as the result of pressure cards which have an adverse effect on them or an adverse effect upon the Everglades. All students will maintain a record of their ESPs on a balance sheet (see sample on page 124). Grades for this game will largely depend upon the number of ESPs earned during the activities. At the conclusion of the study of the Everglades, the teacher will add up all points, arrive at an average for the class, and then assign letter grades according to their own philosophy of grading.

## Pressure Cards

Sample pressure cards are found on pages 126 — 128. The teacher may wish to construct other pressure cards as the study progresses. Pressure cards should be cut out and placed in a box and drawn from time to time to create controversy, to illustrate the consequences of some environmental changes, and to motivate students to seek ways to deal with problems presented by these cards. Pressure cards may serve as springboards for simulated hearings, legislative proposals, small group problem solving sessions, independent study projects, etc. Only the interest and imagination of the students and the teacher can limit the full implications for activities growing from these cards. The teacher should offer generous amounts of ESPs to students who pursue the problems raised in these cards and come up with solutions. The teacher may elect to have a card drawn each day, every other day, or however they wish to use them. These cards can be very successful in motivating students and in creating suspense and excitement in the classroom.

## Resource Collection

Encourage students to collect news articles, books, pamphlets and other items pertaining to their

specific area of environmental concern. Reward students for appropriate donation by giving them ESPs. Fifteen to 25 points per item might be a reasonable guide.

## Advice Forms

A sample of the "Advice Form" is found on page 125. Students may use this form to write advice to the Governor throughout the course of the game. They should write advice about environmental issues and they should complete the form. The Governor will evaluate the Advice forms turned into him and award from 0 to 30 ESPs for each form. Encourage students to write advice forms to the Governor in which they advise him on the course of action to take in regard to the pressure cards which have been drawn. Students might also be made aware that this is an excellent way to gain back points lost due to pressure cards.

## CONCLUSION

After the students have completed all of the activities in the Everglades unit, the concluding activity will be to arrive at answers for the eight inquiry questions found on the following page.

# MAN'S IMPACT ON THE ENVIRONMENT

## Inquiry Questions for Investigating

## Change in an Ecosystem

I. What is a definition of the ecosystem being investigated?

II. What are some of the biotic and abiotic features of the ecosystem and how do these features interrelate?

III. Where are some specific locations of the ecosystem being investigated?

IV. What biotic and abiotic features in the ecosystem have changed and are undergoing change?

V. What are the natural factors causing change in the ecosystem and how have they been brought about?

VI. What are the man-made factors causing change in the ecosystem and how have they been brought about?

VII. What are the results of the changes?

- A. Beneficial?
- B. Detrimental?

VIII. What, if any, new changes are needed in the ecosystem?

IX. How might these needed changes to the ecosystem be brought about?

## CLASS OFFICIALS FOR EVERGLADES SURVIVAL GAME

It would be most helpful to have a class staff of officers to help implement and react to the various activities in this study of the Everglades. Have the students elect a Governor and a Lt. Governor to be the chief officers of the class during this study. The Governor may appoint a Secretary to assist him and the instructor. All students may write advice forms to the Governor about any of the issues which arise during the simulation. If the student advises the Governor to take some action which he has no power to take, he should be prepared to notify the student of the proper governmental agency or the proper course of action to take in implementing the advice given. The Governor and his staff will evaluate all advice forms and award the student who wrote the advice form from 0 to 30 ESPs for their work. (See a copy of the "Advice Form" on page 125.

### SOME OF THE MAJOR DUTIES OF THE GOVERNOR AND HIS STAFF

1. Work with the teacher in coordinating activities, preparing materials, initiating new activities, and presiding over large group sessions.
2. Read, evaluate, and return all Advice Forms.
3. Research all courses of action open to citizens in seeking redress for environmental abuses and refer students to the proper course of action to take to help them in solving environmental problems.
4. The Secretary will check the roll daily, maintain a record of student contributions in class discussions, and assist the Governor in fulfilling his responsibilities.
5. The Governor will serve as the chairman of the "Review Team" in the Jetport Controversy activity.

## PERMANENT ROLES FOR EVERGLADES SIMULATION

(Pressure cards will pertain most to these roles)

1. Citizen of Miami
2. Farmer South of Lake Okeechobee
3. Oil Company President
4. Owner of a Major Tourist Agency in Miami
5. Director of Bureau of Indian Affairs
6. Director of the Water Control Division of Dade County, Florida
7. Head of Florida Highway Department
8. State Secretary of Agriculture
9. President of a Major Land Developing Company
10. Director of Miami Airport
11. Everglades Park Ranger
12. Secretary of the Interior
13. Professional Fisherman off Southern Coast of Florida
14. Camper
15. Citizen of Everglades City
16. Governor of Florida
17. Duck Hunter in New York
18. Poacher

# ESPs BALANCE SHEET

Name

Permanent Role

Activity Roles:

| Date | Activity or Item | - | + | Balance |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
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| | | | | |
| | | | | |
| | | | | |

ADVICE FORM Score _____

Student: _____ Period _____ Governor: _____

Source of Information: _____
Author Title Date Page

_____ _____
Magazine, Newspaper, TV, Role
Authoritative Source, etc.

Information (facts): _____

_____

_____

_____

_____

_____

_____

_____

_____

Because of the above information, I advise you to take the following action: _____

_____

_____

_____

_____

## PRESSURE CARDS

Pressure cards may be introduced by the teacher whenever they would be of the greatest effect in motivating students or the teacher may have students periodically draw cards.

---

PRESSURE CARD #1:

A series of deep canals have been built to drain off water and prevent Lake Okeechobee from overflowing and flooding the area south of the lake. Dikes have also been built as that water will not cover the land and it can be used as farm land. As a result of the construction of the canals and dikes, the rich black soil has dried up in the hot sun and much of it has blown away in clouds of dust, some of the soil has been washed out to sea in the poorly designed drainage canals, and fires have damaged other areas. The peat continues to shrink and it is estimated that in a few more decades, in places, it will be gone forever.

Everyone Loses 10 ESPs
Farmers South of Lake Okeechobee Lose 20 ESPs

---

PRESSURE CARD #2:

The State of Florida has granted the right to a mining company to mine limerock in the big lake, as a result the drinking water for the citizens of Miami will be contaminated. *

All Citizens of Miami Lose 20 ESPs

*This event was almost a reality but was stopped at the last minute in the courts. See how your students choose to handle it.

---

PRESSURE CARD #3:

The Bureau of Indian Affairs has approved extensive leases for oil drilling in the Everglades immediately north of the Park. A total of over a hundred-thousand acres is involved, on two Seminole reservations. Oil has already been brought to the surface within two miles of a main drainage canal that feeds directly into the big reservoir area which sprawls into the heart of the South Florida fresh water system. Conservationists warn of great danger of oil spills and contamination of the entire fresh water system.

Everyone Loses 10 ESPs

PRESSURE CARD #4:

The Director of the Water Control Division of Dade County, Florida, has announced that "The national park is simply going to have to give way to the water demands of people, probably starting around 1985. There won't be enough water for both, and the people come first."

Everyone Loses 10 ESPs

---

PRESSURE CARD #5:

The careless use of pesticides such as DDT, DDD, DDE, BHC and BCB is causing serious poisoning of human :, birds, and animals and destroying the microscopic plants that are responsible for maintaining more than ninety percent of the oxygen we need to remain alive.

Everyone Loses 10 ESPs

---

PRESSURE CARD #6:

It has just been predicted by experts that the continued drainage of the Everglades will result in colder Florida winters, a condition which will in time discourage tourists from coming to Florida.

Tourist Agency Owner Loses 20 ESPs

---

PRESSURE CARD #7:

A major land developer has bought up most of the Big Cypress Swamp area and plans to subdivide and drain the swamp and build a major new housing development in the area.

Everyone Loses 20 ESPs

---

PRESSURE CARD #8:

Florida superhighway planners have announced that they plan to route a new Interstate 75 from the Florida Gulf coast through the Everglades to the eastern side of the state.

Everyone Loses 10 ESPs

PRESSURE CARD #9:

(This card might be used as an introduction to the Jetport Controversy Activities.)

The Dade County (Miami) Port Authority has made plans to build a super airport some 45 miles west of Miami, in the very heart of the glades. This airport is to relieve much of the air traffic pressure on Miami's badly overcrowded air terminal.

Everyone Loses 10 ESPs

---

PRESSURE CARD #10:

Poachers set fire to the sawgrass in the glades in order to uncover alligator holes, destroying many other animals and many acres of vegetation. The poachers skinned and left the remains of several alligators near the holes.

Everyone Loses 10 ESPs

---

PRESSURE CARD #11:

Of all the factors that determine the quality of our environment, the most fundamental is the use we make of our land. Most of the environmental problems we face today stem from the misuse of the land. The way each acre of land is used is of concern to the Community and ultimately to the nation and to the world.

Everyone Loses 20 ESPs

---

PRESSURE CARD #12:

October 6, 1971, an immature Bald Eagle, feeding on carrion on the Sunshine Parkway was struck a glancing blow by a passing vehicle. In a way this accident was the result of many eagles changing their feeding habits due to heavier populations around the lakes where they fish. Animal kills are more frequent and easier to get on the expressways. Consequently the number of eagles being injured and killed is on the rise Our American Symbol is vanishing.

All Patriots Lose 20 ESPs

TEACHER COMMENT NO. 2: Active Involvement From Learning Centers Concept

I. DEFINITION OF LEARNING CENTERS

A harmonious grouping of materials and equipment so arranged as to emphasize some particular idea, principle, or theme growing out of children's various learning activities. (Dictionary of Education)

II. RATIONALE FOR LEARNING CENTERS

A. Increased personalization
B. Developing self-initiating learners
C. Eliminates need for uniform seat work
D. Adapts well to team teaching
E. Ease of implementation
F. Give students practice in decision and self-discipline
G. More teacher freedom
H. Better discipline

III. CHARACTERISTICS OF A LEARNING CENTER

A. Self-instructional
B. Cover several ability levels
C. Seek specific objectives
D. Method of Recording
E. Method of Assessment

IV. KINDS OF CENTERS

A. Subject
   1. Language Arts
      a. Reading
      b. Spelling
      c. Handwriting
      d. English
   2. Math
   3. Science
   4. Social Studies
   5. Religion

B. Interdisciplinary
   1. Music and Social Studies
   2. Art and Science
   3. Language, Math, Science, Music, Art and Religion
   4. Environmental Studies

C. Process or Skill
   1. Questioning
   2. Classifying
   3. Communicating
   4. Listening
   5. Deciding
   6. Awareness
   7. Problem Solving

8. Creating
9. Predicting
10. Valuing
11. Analyzing
12. Synthesizing

V. BUILDING A CENTER

A. Decide how it will be used
B. Choose a topic, goal, and spell out a few objectives
C. Think up learning activities for each objective
D. Gather and make necessary materials
E. Write out clear directions
F. Devise a scheme for recording and evaluation
G. Try it out and make adjustments and repairs

VI. USES OF THE LEARNING CENTER

A. Enrichment
B. Reinforcement
C. Recreation
D. Remediation
E. Motivation
F. Skills of continued learning
G. Academic — Subject Matter

VII. DUTIES FOR THE CHAIRMAN OF THE LEARNING CENTER

A. Check Center before and after an experience, to see if materials are in order.

B. Read materials at Center and locate more materials if needed.

C. Act as a recorder or a referee.

D. Show films at Center or to entire group.

TEACHER COMMENT NO. 3: Life In A Marsh

## PHYSICAL CHARACTERISTICS

A balanced marsh has (1) deep water areas, (2) shallow water areas or shoals, (3) heavy emergent vegetation on some of the shoreline, (4) bare areas on some of its other shores, (5) flooded grassy meadows, and (6) dry grassy meadows.

## ANIMALS AND PLANTS COMMON TO EVERGLADES FRESHWATER MARSH

### Animals

Marsh rabbit
Round-tailed muskrat
Otter
Manatee
Painted bunting
Common egret
Snowy egret
White pelican
Cormorants
Purple gallinule
Common gallinule
Anhinga
Little blue heron
Green heron
Great blue heron
Louisiana heron
Black-crowned night heron
Rail
Everglades kite
Limpkin
Coots (and many other varieties of transient ducks)
American bittern
Stilt
Red-shouldered hawk
Green snake
Banded snake
Everglades swamp snake
Water moccasin
Soft-shelled turtle
Yellow-bellied turtle
Alligator
American crocodile
Green tree frog
Narrow-mouth toad
Southern bullfrog
Mosquitofish (various kinds)
Mullet
Shrimp
Lubber grasshopper
Pomacea snail

### Plants

Arrowhead
Sawgrass
Leather fern
Flag
Maidencane
Pickerel weed
Cattails
Hyacinths
Sedges
Mallow
Lotus
Lily

Also found are occasional Everglades panthers and various kinds of deer.

TEACHER COMMENT NO. 4: Water Control Data Chart

| Year[1] | Rainfall[2] (Yearly total in inches | Water Discharge[3] (Yearly total in acre feet) | Gauge (water) Height[4] (Readings in feet) | |
|---|---|---|---|---|
| | | | Lowest | Highest |
| 1963 | 62.41 | 0 | 2.25 | 6.30 |
| 1967 | 53.52 | 181,400 | 3.98 | 7.10 |

* 1 acre-foot - 43,560 cubic feet

[1]Data for columns 1 and 2 given in calendar year while other columns given in water year.

[2]Readings taken at 40 Mile Bend Rain-gauge Station.

[3]Readings taken at Flood Control Water Gates.

[4]Readings taken at Everglades P-33 water level gauge.

TEACHER COMMENT NO. 5: Pros And Cons Of The Everglades Jetport

A strong case can be made FOR the installation of a new jetport in South Florida. In 1968, Miami International Airport was the 11th busiest airport in the United States, handling a total of 445,000 operations (take-offs and landings) in the year. Completely encircled by urban development, the airport could not be expanded. Records indicated that some 25% of the operations at Miami International were not commercial flights, but training maneuvers for pilots and crews. Therefore, when the Nixon administration decided to bar the further development of the partially-constructed Everglades jetport, it was with the specific provision that the completed runway and tower be used for at least three years as a training field to take some pressure off the overcrowded facilities at Miami International. Although this training procedure does not appear to have inflicted serious damage on the environment at the present time (See Student Comment No. 28, "Meanwhile, Back in the Glades . . .", p. 76 ), the solution is at best short-term, because constantly-growing air traffic is expected to overload Miami International again within the next few years. This process may be accelerated by the conducting of high-intensity "come-to-the-sun" advertising campaigns in northern states. Someday the difficult decisions concerning the Everglades jetport may have to be made all over again. In that event, it will be necessary to re-examine the possible environmental consequences of developing the jetport. Five major problems are anticipated:

1. NOISE POLLUTION. Although the removal of training flights to the Everglades reduced the levels of noise pollution over a large metropolitan area, it brought the problem into a new area. The "jet corridor" to the Everglades facility is only five miles from the reservation of the Miccosukee Indians, who had long been accustomed to the peace and quiet of the Everglades. Furthermore, jet patterns extend over Everglades National Park, causing an unwelcome intrusion upon the wilderness experience of park visitors. The concept of wilderness experience was deliberately included in the act which established the park, and

it is now being eroded. Completion of the Everglades jetport would subject the park to a constant bombardment of noise.

2. AIR POLLUTION. Air pollution from jet operations is different from the pollution caused by emissions from ground-level vehicles. Car exhausts are rapidly diluted by mixing with uncontaminated air above, but pollutants from incoming and outgoing aircraft settle slowly over a long corridor, generally about two miles across and 20 to 40 miles in length. A jetport handling a million operations per year (about twice that of Miami International at capacity) produces nitrogen oxides in an estimated concentration of 20-millionths of a gram per cubic meter of air. Even without adding the pollutants from surface vehicles and factories, this level is approximately twice the level of nitrogen oxides measured in Washington, D. C. (from all sources). Additional airport operations may therefore endanger the usually high quality of air enjoyed by residents (and visitors) of southern Florida.

3. HEALTH HAZARDS FROM INSECTS. Placing an international airport near a large swamp poses the danger of spreading disease. If a swamp insect were to bite a passenger who was ill with a disease for which the insect was a carrier, it could transmit the disease to the next person it contacted. A serious epidemic could conceivably result.

4. PESTICIDES. The solution to #3 creates a new hazard to the environment. World Health Organization standards require daily sprayings of international jetports and adjacent areas with DDT. DDT is a persistent pesticide; after serving its original purpose it remains potent to contaminate the environment for years. The amount of DDT required to combat insects near the Everglades would almost certainly disrupt the ecology of the swamp. DDT from agricultural run-off has already accumulated to a dangerous degree in some species. (See Student Comment No. 8 , "The Problem of Water Pollution in the Everglades," p. 47 ). Even if the standards were changed to allow the use of biodegradable pesticides, the delicate ecology of the Everglades would be threatened.

5. DEVELOPMENT OF SOUTH FLORIDA. The above four problems are direct threats to the environment which might result from the construction of a jetport in or near the Everglades. Possibly the greatest danger of all, however, would be an indirect consequence of building such a facility. A new jetport would undoubtedly stimulate further development of the region -- development which would, in turn, tax the water supply of South Florida, release more pollution into the environment and increase in general the threat to the ecology of the entire region.

Harte, John, and Socolow, Robert H., Patient Earth, Holt, Rinehart, and Winston, Inc., 1971, pp. 193-195.

TEACHER COMMENT NO. 6: Southward Ho!

## FRONTIER DAYS

These words generally conjure up images of stout-hearted, leather-clad cowpokes fighting off blood-thirsty Indians with one hand and black-moustached cattle rustlers with the other; fanatical prospectors with grizzled beards, knapsacks full of dried beans and salt pork, and a golden gleam in their eyes; and swash-buckling Mississippi riverboatmen weaving a perilous path among river shoals, saloon brawls and traps laid by smartly-clad hustling "dudes" from back east.

But the frontier of the Old West was not the only frontier in American history. Another frontier steeped in a tradition of similar color and excitement is to be found right in southern Florida -- in the Everglades and near Lake Okeechobee. Instead of mountains and prairies, it was water and sawgrass. Instead of wagon trains and buffaloes, it was steamboats and alligators. Instead of plows and cattle, it was dredges and catfish. There were Indians, however, and an ample helping of outlaws, eastern city dudes and squatters. The men who first settled in the Everglades faced a wilderness every bit as challenging as the frontier out west.

## UNTAMED WILDERNESS

Although the area south of Lake Okeechobee is today a large complex of farms and ranches with modern urban centers, it wasn't too long ago that the Everglades were virtually untouched, let alone harnessed, by man. The first event of significance in the history of the Lake Okeechobee area occurred in 1837, when Col. Taylor fought with the Seminole Indians. After that there were no white settlers in the area for about 50 years, with the exception of an occasional hunter or a deserter from the Confederate Army. In the 1880's, Hamilton Dissdon brought in dredges to carve a water pathway from his settlement of Kissimmee to Lake Okeechobee, and from the lake to the Gulf of Mexico. Development still didn't take

place on a large-scale basis, however. Men fished for catfish in the area, and stories about the rich potential of the land under the Everglades began to drift toward Tallahassee. Seeking a new source of revenue (the state had already given away most of the public land north of the Everglades to the railroads), Governor William S. Jennings in 1901 looked upon the Everglades with new interest. The territory had been granted to Florida by the federal government in 1850 with the provision that it would be drained, but no one had been interested. Now the governor was interested. Jennings' successor, Governor Broward, got the drainage project underway by selling large acreages of the wet and undeveloped sawgrass prairie to sales organizations which, in turn, launched a nation-wide publicity campaign to sell the land in 10 and 20-acre parcels. However, the plan backfired. The task of drainage was too great and funds were too limited. Settlers' dreams were burst on the sharp spikes of sawgrass, drowned by floods during the rainy season, bogged down in the fertile but nearly unmanageable muck, and even frozen during winter frosts (a hazard the national sales promoters had neglected to mention in their panoramas of a tropical paradise). The sawgrass settlers were unable to make a go of it. Some retreated to higher land on the shore of Lake Okeechobee, where they were able to scratch out a meager existence, still beset with numerous hardships. Others left altogether.

## DOWN THE DRAIN!

More canals were dug, to control the natural overflow from Lake Okeechobee (which flowed southward into the Everglades) and to drain the sawgrass regions. During seven years of limited rainfall, the drainage was successful. In fact, the Upper Everglades became so dry that fires raged out of control on the high ridge of land south of Lake Okeechobee. Vegetables and sugar cane were planted. But the canals had not been the only cause in controlling the water system of the area. Nature's "cooperation" (in the form of limited rainfall) had been essential. When the heavy rains returned, farmers were again flooded out.

To protect residents in communities along the south shore of the lake, a hurricane dike was constructed. The hurricanes of 1924 and 1928 proved more than a match for the flimsy structure, however. Lake Okeechobee surged outward over its southern rim into the sawgrass prairie, and thousands perished. (See Student Comment #5, "Nature Strikes Back," p. 35). Still the frontier spirit prevailed, just as it did against tornadoes and dust storms out west. The government responded to the disasters by erecting the Hoover Dike, a much more formidable levee which afforded real protection. As a result, settlement soon boomed along the lake shore. A whole new wave of pioneers moved into the region in the 1930's and 1940's. They built dikes and installed pumps at their own expense to drain stretches of the sawgrass swamp in order to tap the agricultural potential of the rich black peat. They planted hundreds of acres of vegetables and converted even larger tracts of sawgrass into pastureland. But still the spectre of watery disaster lurked in the wings. Sure enough, in flood times the entire northern region of the Everglades was submerged with 3-4 feet of water. When the embattled farmers tried to pump the floodwaters off their crops, they had no place to put it! And during droughts there was no source of water to be found. Nevertheless, farmers managed to reap some excellent harvests from the rich peat, but it was a risky venture at best.

## HERE COMES THE CAVALRY!

In the Wild West, the settlers were often saved from Indians by the welcome sight of the cavalry charging over the hill in a cloud of dust and clamor of trumpets. For the beleaguered Everglades farmer, the "cavalry" was the Central and South Florida Flood Control District and its collaborator, the Army Corps of Engineers. These organizations have completed a large-scale project which no individual farmer could ever attempt -- deepening canals, building miles of big dikes and installing huge pumps. Even in its incomplete stages, the new flood control network greatly lessened the risk of losing crops to rampant floodwaters. The growing system of canals and pumps also held the promise of a controlled, stable water

supply even during periods of drought. It seems as if the 20th century is finally converting the Everglades settlers from pioneers to modern, scientific farmers . . . but the road has been long and arduous.

Will, Lawrence E., A Cracker History of Okeechobee, The Great Outdoors Association Craftsmen, 1964, Chapter One, "A Heck of a Frontier," pp. 1-4.

TEACHER COMMENT NO. 7: Evaluation Form For Oral Report
(To be filled in by students and/or teacher)

Subject of Report_____ Student reporting_____

I. Knowledge of subject matter and/or what way questions were answered.

_____a. Excellent (5 points) _____b. Good (4 points) _____c. Fair (3 points)
_____d. Poor (1 point)
Points Earned_____

II. Presentation of material by using audio/visual aids. Evaluate each aid used from 0--5 points.

_____a. Charts _____b. Maps _____c. Graphs
_____d. Guest Speaker _____e. Slides _____f. Films
_____g. Filmstrips _____h. Table Display _____i. Study Guides
_____j. Puzzles/Games _____k. Skits _____l. Other
Points Earned_____

III. Equipment used in presentation. Evaluate each aid used from 0--5 points.

_____a. Opaque Projector _____b. Filmstrip Projector _____c. Overhead Projector
_____d. Film Projector _____e. Globe _____f. Chalkboard
Points Earned_____

IV. Speaker's attitude towards listeners, tone, and quality of voice should be considered. Evaluate as #1.

_____a. Excellent _____b. Good _____c. Fair
_____d. Poor
Points Earned_____

V. Evaluation of the participation of the members of the groups. (Use where applicable)

_____a. Excellent _____b. Good _____c. Fair
_____d. Poor
Points Earned_____
Total Points_____