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Introducing Aquatic Ecology to Ninth Graders

Inez P. Sutton

INTRODUCING AQUATIC ECOLOGY TO NINTH GRADERS

by
Inez P. Sutton

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Faculty Advisory Committee:

Associate Professor Beth Schultz, Chairman
Assistant Professor Thane S. Robinson
Professor William C. Van Deventer

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CHAPTER I

INTRODUCTION

In discussing the basis for teaching high school biology, Van Deventer[1] states, "...the present typical course in high school biology serves adequately neither the terminal student nor the college entrance student." He holds that today's courses present watered-down versions of college courses to the student before the intelligence of the student has matured enough to grasp such subject matter. As a result there is very little carry-over value from such courses, and the students may even develop a dislike for biology. This study constitutes an effort to understand these problems and to devise ways of solving them.

Statement of the Problem.

The problem for this project was to develop a unit of study for a ninth grade biology class which would result in a cooperative learning situation for all involved. The basic biological principles of the unit

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[1]W. C. Van Deventer, "A Rationale for the Teaching of Biology," School Science and Mathematics, 60 (February, 1960), 115.

are those involved in the concept of the biotic community. The laboratory work consisted of field and classroom study of an aquatic community--its physical and biotic factors.

Importance of the Study.

The planning of a unit of study of an aquatic community which would avoid the difficulties mentioned by Van Deventer[1] was a challenging task. A teacher can find only a few aids. In a search of educational literature published between January, 1929, to June, 1960, the writer found only five articles dealing with ecology in the high school biology course:

(1) "Teaching Ecology in High School Biology" by R. A. Bullington, who lists reasons and various suggested methods for teaching ecology in high school.[2]

(2) "Ecology at the Beginning of a High School Biology Course" by I. Hollenbeck, who tells about the introduction of field studies in ecology to solve the problem of poor trout fishing in a local stream.[3]

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[1]Van Deventer, *op. cit.*, p. 115.

[2]R. A. Bullington, "Teaching Ecology in High School Biology," The American Biology Teacher, 20:163-165, May, 1958.

[3]I. Hollenbeck, "Ecology at the Beginning of a High School Biology Course," The American Biology Teacher, 18:9-13, January, 1956.

(3) "Quadrat: An Approach to the Study of Ecology" by R. E. Brown, who uses an outdoor laboratory exercise involving the quadrat as a meaningful study of conservation.[4]

(4) "Ten Classroom Sessions in Ecology" by Howard T. Odum, who explains in detail ten ecological exercises which can be performed in the average biology classroom.[5]

(5) "Urban Biology: An Ecological Approach" by Beth Schultz, who suggests resources and methods for teaching ecology in the city.[6]

None of the foregoing articles involves a specific ecological study of a pond. Therefore this is a new and detailed plan of study of a pond near White Pigeon High School, and a description of the work done by a class of ninth graders who studied the pond as an aquatic community.

The method of study of Fetch Pond used by the ninth grade biology class at White Pigeon High School, St. Joseph County, Michigan, involved an effort to design experiences which could result in learning for all students, including both slow and rapid learners. It was hoped that this would enable each student to participate in a series of laboratory experiences, and also to

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[4]R. E. Brown, "Quadrat: An Approach to the Study of Ecology," The American Biology Teacher, 21:45-47, February, 1959.

[5]H. T. Odum, "Ten Classroom Sessions in Ecology," The American Biology Teacher, 22:71-78, February, 1960.

[6]B. Schultz, "Urban Biology: An Ecological Approach," The American Biology Teacher, 22:147-152, March, 1960.

be better able to interpret his own environment in the future. The method used was planned to develop also the student's ability to think scientifically by increasing his ability to note likenesses and differences of organisms, and to help him understand ecology well enough to predict what will probably happen under a given set of conditions.

Procedure in the Study.

The procedure followed in developing the unit on aquatic ecology was:

(1) Locating and studying of a suitable aquatic site by the teacher.

(2) Planning a teaching unit on aquatic ecology.

(3) Teaching the unit.

(4) Evaluation of the unit by the students and the teacher.

CHAPTER II

BIOLOGICAL SURVEY OF FETCH POND--AN AQUATIC COMMUNITY

I. THE TEACHER ACQUIRES BACKGROUND FOR TEACHING THE UNIT

To prepare for undertaking and guiding an ecological study, the teacher needed to develop her own understanding of ecology, and to locate and survey the study site.

Ecology is a comparatively new science--an organized body of knowledge which deals with the interrelationships between living organisms and their environment. The term comes from the Greek words meaning a "study of the house" and has come into use since the mid-nineteenth century. However, the observation of animals and plants has been going on since man began using them as sources of food and clothing and combating them as enemies. To know where and at what time to find fruits; where and when to hunt for game; where, when, and how deep to plant seeds--this knowledge was needed for survival.

The role of the ecologist involves his organizing old and new facts concerning the natural world into statements of principles and laws which help to describe how, where, and when natural events take place, and to predict what will happen under a given set of conditions.

Today, in a world in which the human population is rapidly increasing, as well as expanding its means of communication and travel, human exploitation of the natural world is proceeding at an alarming rate. If the human race is to survive, every individual must be made aware of ecological principles so that he may use foresight, and practice intelligent conservation. To accomplish this, each individual must learn to make careful observations, and to use these in interpreting the total environment.

A natural community may be as large as the Sahara Desert or as small as a sand trap on a golf course. It may be as temporary as a rotting log, or as lasting as a grassy meadow. Natural communities are not like neatly fenced-in fields. They overlap as a shrub area overlaps with a forest community, and such a transition zone is called an ecotone. Natural communities change. For example, a pond community will differ during the rainy season and the dry season.

> The variety of physical habitats, interacting with the plants and animals that have come to live in them, have produced definite and characteristic assemblages of plants and animals which we call communities.[7]

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[7]Ralph and Mildred Buchsbaum, 1957. Basic Ecology. The Boxwood Press, Pittsburgh, Pennsylvania. p. 58.

Man's understanding of natural communities is important. Each biotic community has a definite structure. There are special functions or niches for each organism in the community. There are food-producers or green plants. There are plant-eaters (herbivores or converters), which are often called key-industry animals because they support all the predators of the community. There are consumers or carnivores: first-level carnivores which feed on the key-industry animals, second-level carnivores which feed on the first-level ones, and parasites which take their food from other organisms without killing them. The reducers include scavengers that feed on dead organic material, the decomposers, and the transformers which break down wastes and dead bodies of organisms. These reorganize nitrogen and carbon compounds into forms which can be re-used by green plants in photosynthesis. This renews the food supply of the community.

Near White Pigeon High School is a pond community, Fetch Pond. This pond is accessible for a study of the structure of a natural community. The writer made an ecological study of Fetch Pond during the summer months of 1960 in order to enrich her own background, as well as to determine whether or not the site would be suitable for study by a ninth grade biology class.

Her study had these goals:

(1) To determine the geological origin of Fetch Pond.

(2) To list the flora and fauna of this pond.

(3) To determine the food web of the community.

(4) To determine the relationship of this pond to activities of the citizens of White Pigeon, Michigan.

II. THE TEACHER MAKES A STUDY OF FETCH POND

On June 26, 1960, the writer visited the area, made a sketch of Fetch Pond (Figure 1), and photographed it (Plates I and II).

On the same day, the information for Figure 2 was obtained by rowing a boat across Fetch Pond, dropping a weighted rope and measuring the depth of the water. The sub-surface temperature of the water was also measured and recorded at this time.

A total of five field trips was taken during June and July of 1960 to Fetch Pond. From the collections made on these trips, the teacher compiled Table I, Flora of Fetch Pond, and Table II, Fauna of Fetch Pond. Figures 3, 4, and 5--Stratification Maps of Sites I, II, and III, respectively--were drawn.

Figure 6 shows the concentration of oxygen and the temperature of the water at the sites studied. Figure 7 shows the probable food web at Fetch Pond.

Description of the Fetch Pond Area.

This pond lies at the west end of a field on the farm of Mr. Louis Fetch of White Pigeon, NE $\frac{1}{4}$, Sec. 7, White Pigeon Township, St. Joseph County, Michigan. Mr. Fetch had planted corn on both the east and south sides of the pond in the summer of 1960.

The pond covers an area approximately 30 rods long and 15 rods wide. It lies directly east of the White Pigeon Community School football field. A five-minute walk enables one to reach the pond after leaving the biology classroom in the high school building. This makes the pond easily accessible.

Geological Origin of Fetch Pond.

The present topography of the White Pigeon Area is that of an outwash plain. During the Pleistocene Epoch, the state of Michigan was affected by the Wisconsin glaciation.

When streams flowed from the front of a continental ice sheet through well-defined valleys, they formed valley trains. Overlapping of valley trains resulted in

an outwash plain.[8] Sometimes outwash plains are "pitted," in that the general level may be broken by more or less rounded depressions. The pits are called kettle holes and are believed to have been formed by the melting of blocks of ice which had been left buried in the drift as the ice retreated.[9]

Present Relationship of Fetch Pond Community and the White Pigeon Community.

The predominant life forms at Fetch Pond are willow shrubs (*Salix* sp.), bulrush (*Scirpus* sp.), horsetail (*Equisetum* sp.), duckweeds (*Wolffia* sp. and *Lemna minor*), sedge (*Cyperus* sp.), marsh grass (*Spartina* sp.), insects (Coleoptera, Hemiptera, Odonata, and Diptera), red-wing blackbirds (*Agelaius* sp.), catbirds (*Dumetella* sp.), and cardinals (*Richmondena* sp.).

White Pigeon is a small town with a population of about one thousand persons. Small boys of the town enjoy playing at Fetch Pond. There are large cherry orchards in the vicinity of White Pigeon, and there are

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[8]Herdman F. Cleland. 1916. *Geology, Physical and Historical.* American Book Company, Chicago, Illinois. p. 717.

[9]Frederic H. Lahee. 1916. *Field Geology.* McGraw-Hill Book Co., New York, New York. p. 528.

farms surrounding the town. The Fetch Pond area is a haven for the birds which feed on the insects that in turn feed on the orchards and agricultural grain crops.

Fetch Pond also furnishes an excellent source of material for the biology classes at White Pigeon Community School.

The pond also is a breeding place for many mosquitoes which feed on White Pigeon citizens. No malaria, however, has been recorded in the area for many years.

Future Relationships of the Pond Area and the White Pigeon Community.

If agriculture of the present type is continued on the south and east sides of Fetch Pond, erosion will slowly fill in the pond area and destroy it.

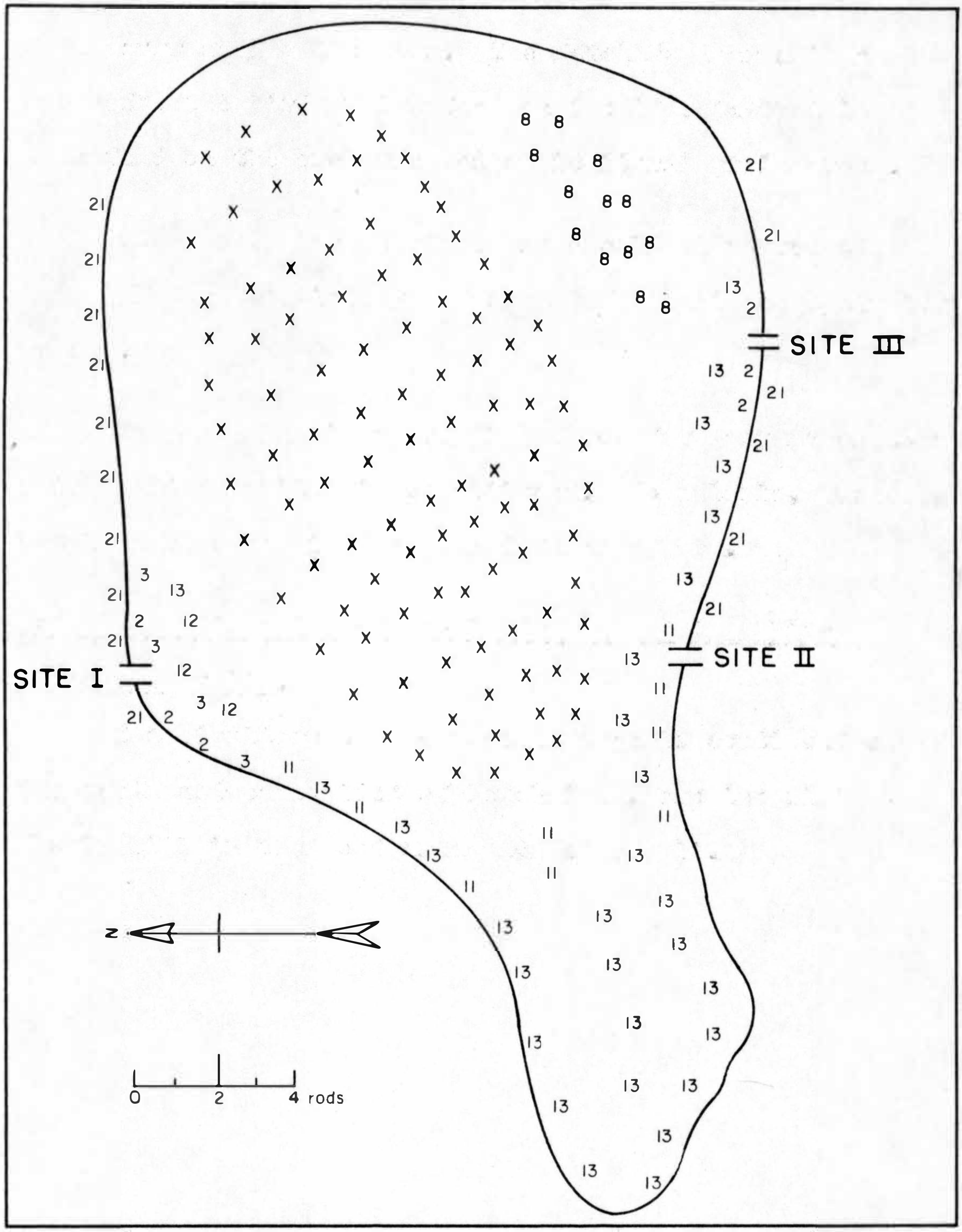

Figure 1. Sketch of Fetch Pond showing distribution of vegetation. Symbols as follows: 2) *Equisetum*, 3) *Scirpus*, 8) *Typha*, 11) *Cyperus*, 12) *Polygonum*, 13) *Spartina*, 21) *Salix*, X) *Nymphaea*.

a. Fetch Pond, view of Site I, looking west from east end of pond.

b. Fetch Pond, general view looking east from west end of pond. (Photos taken June 26, 1960)

a. Fetch Pond, view of Site III, looking south from north end of pond. Notice cultivation of south slope.

b. Fetch Pond, view of Site III, looking north from south end of pond. (Photos taken June 26, 1960)

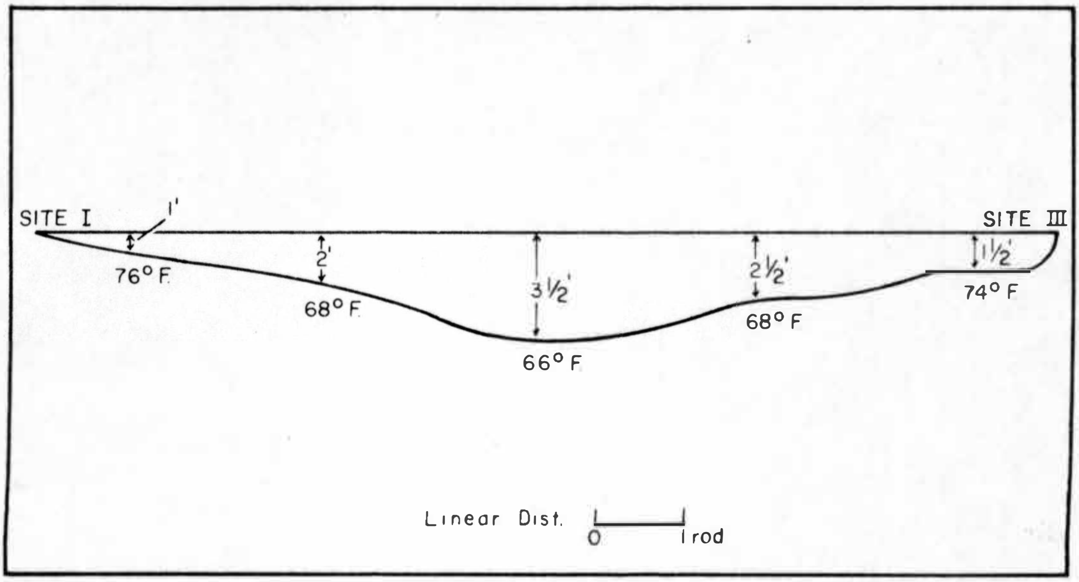

Figure 2. Diagrammatic cross-section of Fetch Pond. Depths and temperatures determined June 26, 1960. Vertical distances exaggerated in diagram.

TABLE I

FLORA OF FETCH POND AND ADJACENT HABITATS

Name	Site	Location	Trophic Level
1. Nightshade (*Solanum* sp.)	1	On shore, on log lying in water	Producer
2. Horsetail (*Equisetum* sp.)	1,3	Water's edge	Producer
3. Bulrush (*Scirpus* sp.)	1	In water's edge	Producer
4. Mulberry Shrub (*Morus* sp.)	1	Shore	Producer
5. Elderberry (*Sambucus* sp.)	1	Shore	Producer
6. Milkweed (*Asclepias* sp.)	1	Shore	Producer
7. Alga (*Spirogyra* sp.)	1,3	In water	Producer
8. Cat-tails (*Typha* sp.)	3	In water	Producer
9. Duckweed (*Wolffia* sp.)	2,3	In water	Producer
10. Duckweed (*Lemna minor*)	1,2,3	In water	Producer
11. Sedge (*Cyperus* sp.)	1,2	At water's edge	Producer

12. Water Smart-weed (Polygonum sp.)	1	Shore and in water	Producer
13. Marsh Grass (Spartina sp.)	1,2,3	Shore and in water	Producer
14. Swamp Thistle (Cirsium sp.)	1	On edge amidst the marsh grass	Producer
15. Alga (Oscillatoria sp.)	3	Water	Producer
16. Algae (Desmids)	3	Water	Producer
17. Algae (Diatoms)	3	Water	Producer
18. Alga (Volvox)	3	Water	Producer
19. Bacteria (Schizomycetes)	1,2,3	In mud and water	Reducer
20. Black-eyed Susan (Rudbeckia sp.)	2	In marsh grass	Producer
21. Willow Shrubs (Salix sp.)	1,3	On shore	Producer

Location of Sites: 1) North Side, mid-center; 2) South Side, mid-center; 3) South Side, east corner.

See Table II for explanation of trophic levels.

TABLE II

FAUNA OF FETCH POND AND ADJACENT HABITATS

Name	Site	Location	Food	Trophic Level
Protozoa				
22. *Paramecium* sp.	1	Water	Bacteria	Converter
Rotifera				
23. Rotifers (Rotifera)	1	Water	Microscopic organisms	Consumer
Bryozoa				
24. Bryozoans (Bryozoa)	1	Water	Diatoms and algae	Converter
Porifera				
25. Fresh Water Sponge (*Spongilla* sp.)	3	Water	Microscopic organisms	Consumer
Coelenterata				
26. *Hydra* sp.	3	Water	Microcrustacea, minute worms, young insects	Consumer

Aschelminthes				
27. Nematode (Nematoda)	1	Mud	Microscopic organisms	Consumer
Annelida				
28. Leech (Hirudinea)	1,2,3	Mud	Blood of frogs, turtles, salamanders	Consumer
29. Bristleworm (Oligochaeta)	3	Mud	Decaying plants	Reducer-Scavenger
Mollusca				
30. Snails (Gastropoda)	1,2,3	Water	Aquatic plants and droppings	Reducer-Scavenger
Arachnida				
31. Spider (Arachnida)	1	Grass above water	Cranefly, other insects	Consumer
32. Red Water Mites (Hydracarina)	1,3	Water	Carnivorous feeders	Consumer
Crustacea				
33. Sowbugs (Isopoda)	1	Mud	Dead Leaves	Reducer-Scavenger
34. Water-fleas (*Daphnia* sp.)	1,3	Water	Algae	Converter

Insecta

35. Stinkbug (Pentatomidae)	1	On grass	Cruciferous plants	Converter
36. American Copper Butterfly (Lepidoptera)	1	In air	Nectar of flowers	Converter
37. Sulfur Butterfly (*Pieris* sp.)	1	In air	Nectar of flowers	Converter
38. Black Cricket (*Nemobius* sp.)	1	In grass	Plants	Converter
39. Green Leaf Hopper (Cicadellidae)	1,2	On grass	Plant juices	Converter
40. Boll Weevil (*Anthonomus* sp.)	2	On grass	Plant juices	Converter
41. Ants (Formicidae)	1	On grass	Plant juices	Converter
42. Grasshopper (*Schistocerca* sp.)	1	On grass	Plants	Converter
43. Dragonflies (Odonata)	1,2,3	In air	Mosquitoes, insects, midges	Consumer
44. Damselflies (Zygoptera)	1,2,3	On grass	Mosquitoes, other insects	Consumer

45. Caddis Fly (Trichoptera)	1	On grass	Larvae feed on vegetation	Converter
46. Mole Cricket (Gryllotalpa sp.)	2	In mud	Rootlets, insect larvae	Converter-Consumer
47. Mosquito (Culex sp.)	1,2,3	Air, grass	Larvae - plants Adults - blood, and plants	Converter-Consumer
48. Midge (Chironomidae)	1	Above grass	Algae, vegetable matter	Converter
49. Syrphid Fly (Syrphidae)	1	Air	Larvae - organic matter; Adults - flowers.	Converter
50. Crane Fly (Tipulidae)	3	Air	Larvae -Diatoms, algae; Adults - flowers	Converter
51. Black Fly (Simuliidae)	1	On grass	Larvae - Diatoms Adults - Blood	Converter-Consumer
52. Robber Fly (Asilidae)	2	On grass	Dragonflies, Damselflies	Consumer
53. Whirligig Beetles (Gyrinidae)	1	Water	Bloodworms, other insects	Consumer
54. Diving Beetles (Dytiscidae)	1,3	Water	Worms, Leeches, other insects	Consumer

55.	Crawling Water Beetles (Gyrinidae)	1	Water	Plants and animals	Converter-Consumer
56.	Willow Leaf Beetle (Chrysomelidae)	3	Willow	Plants	Converter
57.	Variegated Mud-loving Beetle (Heteroceridae)	1	In mud	Organisms in ooze	Reducer
58.	Leaf Lily Caterpillar (*Nymphula* sp.)	1	On grass	Algae, diatoms	Converter
59.	Soldier Fly (Stratiomyiidae)	1	Larvae in water	Larvae-Carnivores Adults-Flowers	Consumer-Converter
60.	Water Scorpion (*Ranatra* sp.)	2	Grass in water	Crustacea, mosquito larvae	Consumer
61.	Water Boatmen (*Corixa* sp.)	1,3	Water	Ooze, algae, diatoms, midge and mosquito larvae	Converter-Consumer
62.	Back Swimmers (*Notonecta* sp.)	1,3	Water	Small crustacea, insects	Consumer
63.	Giant Water Bug (*Belostoma* sp.)	1,3	Water	Insects, snails, tadpoles	Consumer
64.	Water Strider (*Gerris* sp.)	1,3	On water	Other insects	Consumer

Amphibia				
65. Tadpole (*Rana* sp.)	3	Water	Algae	Converter
66. Leopard Frog (*Rana pipiens*)	1,2	Water	Insects, worms, snails	Consumer
67. Spotted Newt (*Triturus* sp.)	3	Water	Snails, small crustacea	Consumer
68. Swamp Chorus Frog (*Pseudacris triseriata*)	2	Water	Insects, worms, snails	Consumer
69. Green Frog (*Rana clamatans*)	1	Muddy edge	Insects, worms, snails	Consumer
70. Spring Peeper (*Hyla crucifer*)	3	In grass	Worms, small insects	Consumer
Reptilia				
71. Common Water Snake (*Natrix sipedon*)	1	Grass edge	Frogs	Consumer
72. Painted Turtle (*Chrysemys picta*)	1,3	Floating board	Tadpoles, snails, insects	Consumer
Aves				
73. Red-winged Blackbird (*Agelaius* sp.)	2,3	Air, trees	Insects	Consumer

74. Bluejay (Cyanocitta sp.)	3	Trees	Insects	Consumer
75. Brown Thrasher (Toxostoma rufum)	2	Air	Insects	Consumer
76. Killdeer (Oxyechus sp.)	2	Ground	Insects	Consumer
77. Blue Heron (Ardea sp.)	3	Water's edge	Frogs, salamanders, insects, snakes	Consumer
78. Catbird (Dumetella carolinensis)	1	Tree	Insects, fruits	Consumer-Converter
79. Song Sparrow (Melospiza sp.)	2	Shrub, air	Insects, seeds	Consumer-Converter
80. Cardinal (Richmondena sp.)	3	Tree	Insects, seeds	Consumer-Converter

Note: In this pond community study all the organisms are grouped into four main categories: Producers, Converters, Consumers, and Reducers. The producers consist of the green plants; the converters are the herbivores. The consumers consist of all carnivores, first and second level, and the parasites. The reducers include scavengers, decomposers, and transformers.

Location of Sites: 1) North Side, mid-center; 2) South Side, mid-center; 3) South Side, east corner.

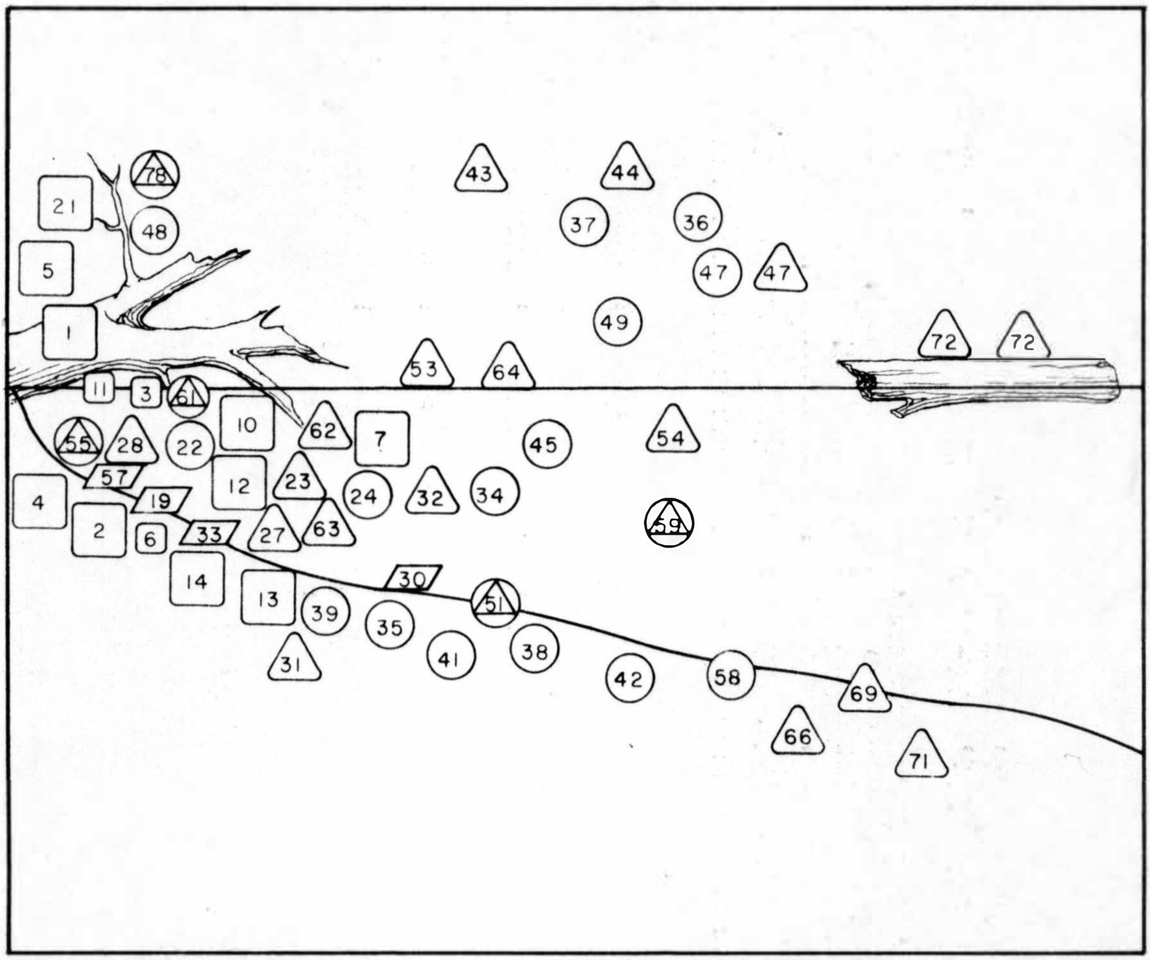

Figure 3. Diagrammatic ecological stratification at Site I, Fetch Pond. Symbols as follows:

□ producer ○ converter △ consumer ▱ reducer

Figure 3. Legend

1. Nightshade (*Solanum* sp.)
2. Horsetail (*Equisetum* sp.)
3. Bulrush (*Scirpus* sp.)
4. Mulberry (*Morus* sp.)
5. Elderberry (*Sambucus* sp.)
6. Milkweed (*Ascelpias* sp.)
77. Alga (*Spirogyra* sp.)
10. Duckweed (*Lemna minor*)
11. Sedge (*Cyperus* sp.)
12. Water Smartweed (*Polygonum* sp.)
13. Marsh Grass (*Spartina* sp.)
14. Swamp Thistle (*Cirsium* sp.)
19. Bacteria (Schizomycetes)
21. Willow (*Salix* sp.)
22. *Paramecium*
23. Rotifer (Rotifera)
24. Bryozoan (Bryozoa)
27. Nematode (Nematoda)
28. Leech (Hirudinea)
30. Snail (Gastropoda)
31. Spider (Arachnida)
32. Red Water Mite (Hydracarina)
33. Sowbug (Isopoda)
34. Water-fleas (*Daphnia* sp.)
35. Stinkbug (Pentatomidae)
36. American Copper Butterfly (Lepidoptera)
37. Sulfur Butterfly (*Pieris* sp.)
38. Black Cricket (*Nemobius* sp.)
39. Green Leaf Hopper (Cicadellidae)
41. Ants (Formicidae)
42. Grasshopper (*Schistocerca* sp.)
43. Dragonflies (Odonata)
44. Damselflies (Zygoptera)
45. Caddis Fly (Trichoptera)
47. Mosquito (*Culex* sp.)
48. Midge (Chironomidae)
49. Syrphid Fly (Syrphidae)
51. Black Fly (Simuliidae)
53. Whirligig Beetle (Gyrinidae)
54. Diving Beetle (Dytiscidae)
55. Crawling Water Beetle (Gyrinidae)
57. Variegated Mud-loving Beetle (Heteroceridae)
58. Leaf Lily Caterpillar (*Nymphula* sp.)

59. Soldier Fly Larva
(Stratiomyiidae)

61. Water Boatmen (*Corixa* sp.)

62. Backswimmers (*Notonecta* sp.)

63. Giant Water Bug (*Belostoma* sp.)

64. Water Strider (*Gerris* sp.)

66. Leopard Frog (*Rana pipiens*)

69. Green Frog (*Rana clamitans*)

71. Common Water Snake
(*Natrix sipedon*)

72. Painted Turtle (*Chrysemys picta*)

78. Catbird (*Dumetella carolinensis*)

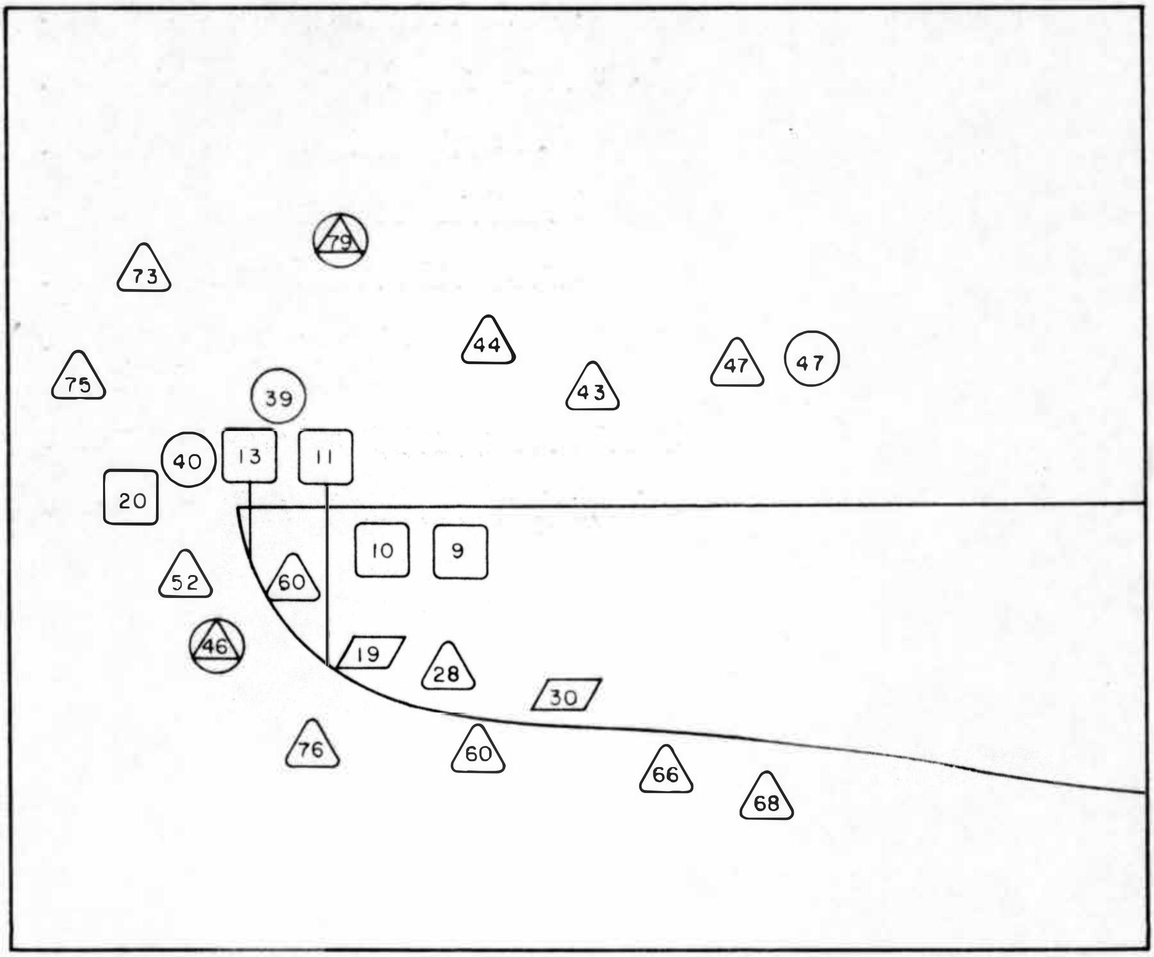

Figure 4. Diagrammatic ecological stratification at Site II, Fetch Pond. Symbols as follows:

□ producer ○ converter △ consumer ▱ reducer

Figure 4. Legend

9. Duckweed (*Wolffia* sp.)
10. Duckweed (*Lemna minor*)
11. Sedge (*Cyperus* sp.)
13. Marsh Grass (*Spartina* sp.)
19. Bacteria (Schizomycetes)
20. Black-eyed Susan (*Rudbeckia* sp.)
28. Leech (Hirudinea)
30. Snails (Gastropoda)
39. Green Leaf Hopper (Cicadellidae)
40. Boll Weevil (*Anthonomus* sp.)
43. Dragonflies (Odonata)
44. Damselflies (Zygoptera)
46. Mole Cricket (*Gryllotalpa* sp.)
47. Mosquito (*Culex* sp.)
52. Robber Fly (Asilidae)
60. Water Scorpion (*Ranatra* sp.)
66. Leopard Frog (*Rana pipiens*)
68. Swamp Chorus Frog (*Pseudacris triseriata*)
73. Red-winged Blackbird (*Agelaius phoenicius*)
75. Brown Thrasher (*Toxostoma* sp.)
76. Killdeer (*Oxyechus rufum*)
79. Song Sparrow (*Melospiza* sp.)

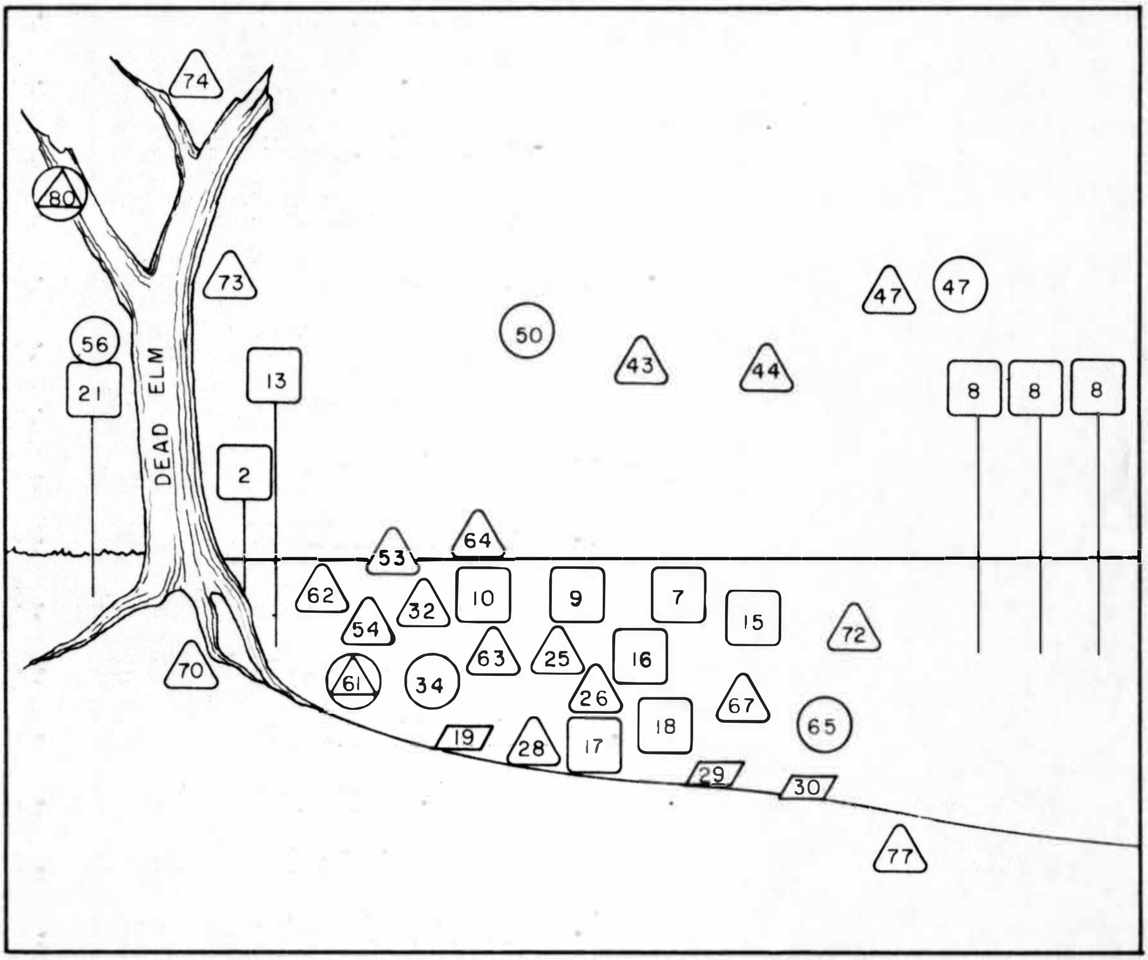

Figure 5. Diagrammatic ecological stratification at Site III, Fetch Pond. Symbols as follows:

producer converter consumer reducer

Figure 5. Legend

2. Horsetail (*Equisetum* sp.)
7. Alga (*Spirogyra* sp.)
8. Cat-tails (*Typha* sp.)
9. Duckweed (*Wolffia* sp.)
10. Duckweed (*Lemna minor*)
13. Marsh Grass (*Spartina* sp.)
15. Alga (*Oscillatoria* sp.)
16. Algae (Desmids)
17. Algae (Diatoms)
18. Alga (*Volvox* sp.)
19. Bacteria (Schizomycetes)
21. Willow (*Salix* sp.)
25. Fresh Water Sponge (*Spongilla* sp.)
26. *Hydra*
28. Leech (Hirudinea)
29. Bristleworm (Oligochaeta)
30. Snails (Gastropoda)
32. Red Water Mites (Hydracarina sp.)
34. Water-fleas (*Daphnia* sp.)
43. Dragonflies (Odonata)
44. Damselflies (Zygoptera)
47. Mosquito (*Culex* sp.)
50. Crane Fly (Tipulidae)
53. Whirligig Beetle (Gyrinidae)
54. Diving Beetle (Dytiscidae)
56. Willow Leaf Beetle (Chrysomelidae)
61. Water Boatmen (*Corixa* sp.)
62. Backswimmers (*Notonecta* sp.)
63. Giant Water Bug (*Belostoma* sp.)
64. Water Strider (*Gerris* sp.)
65. Tadpole (*Rana* sp.)
67. Spotted Newt (Triturus sp.)
70. Spring Peeper (*Hyla crucifer*)
72. Painted Turtle (*Chrysemys picta*)
73. Red-winged Blackbird (Agelaius phoeniceus)
74. Bluejay (*Cyanocitta cristata*)
77. Blue Heron (*Ardea* sp.)
80. Cardinal (*Richmondena cardinalis*)

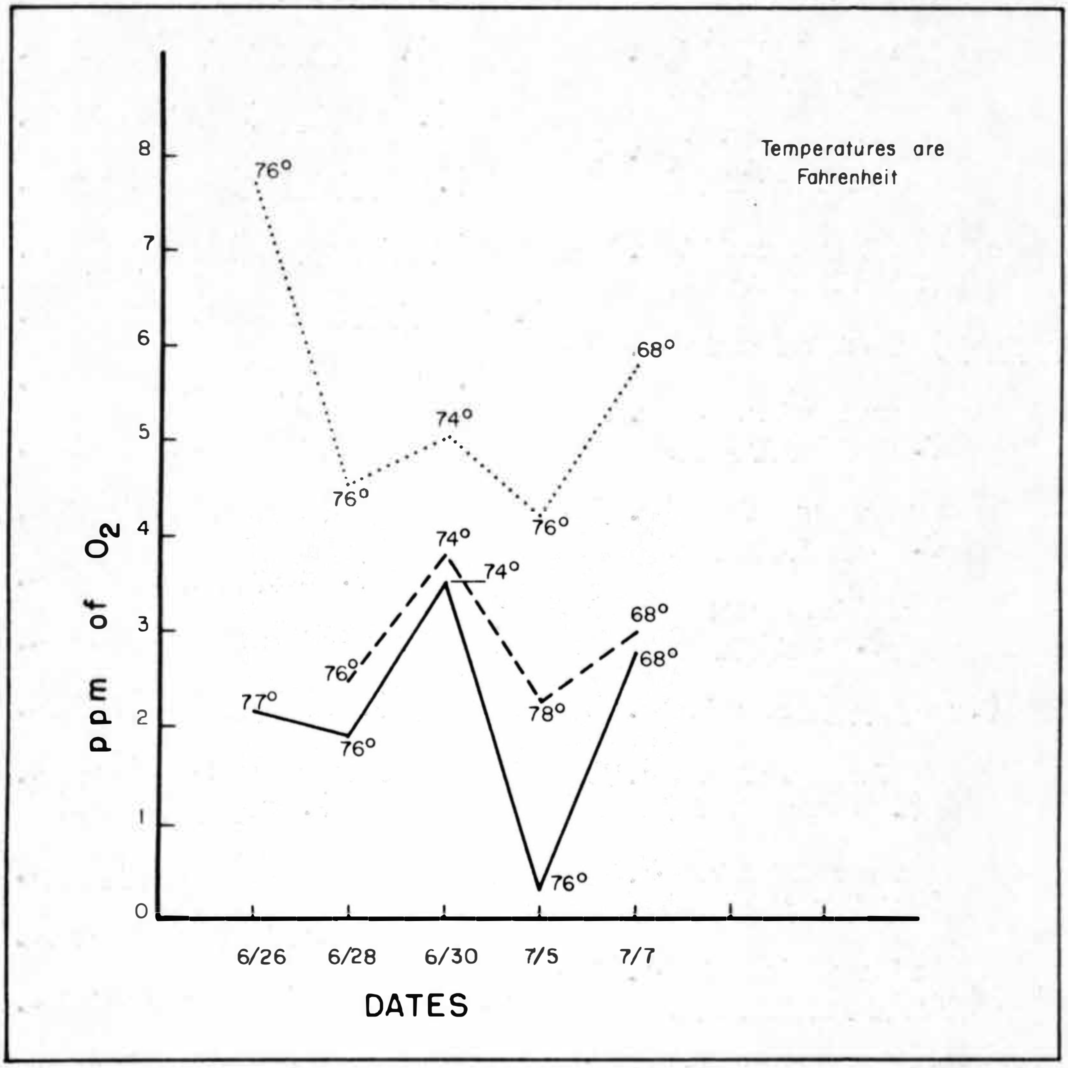

Figure 6. Concentration of oxygen and temperature of water studied on various dates. Depth at Site I: 8 inches, at Site II: 12 inches, at Site III: 14 inches. Solid line, Site I; broken line, Site II; dotted line, Site III.

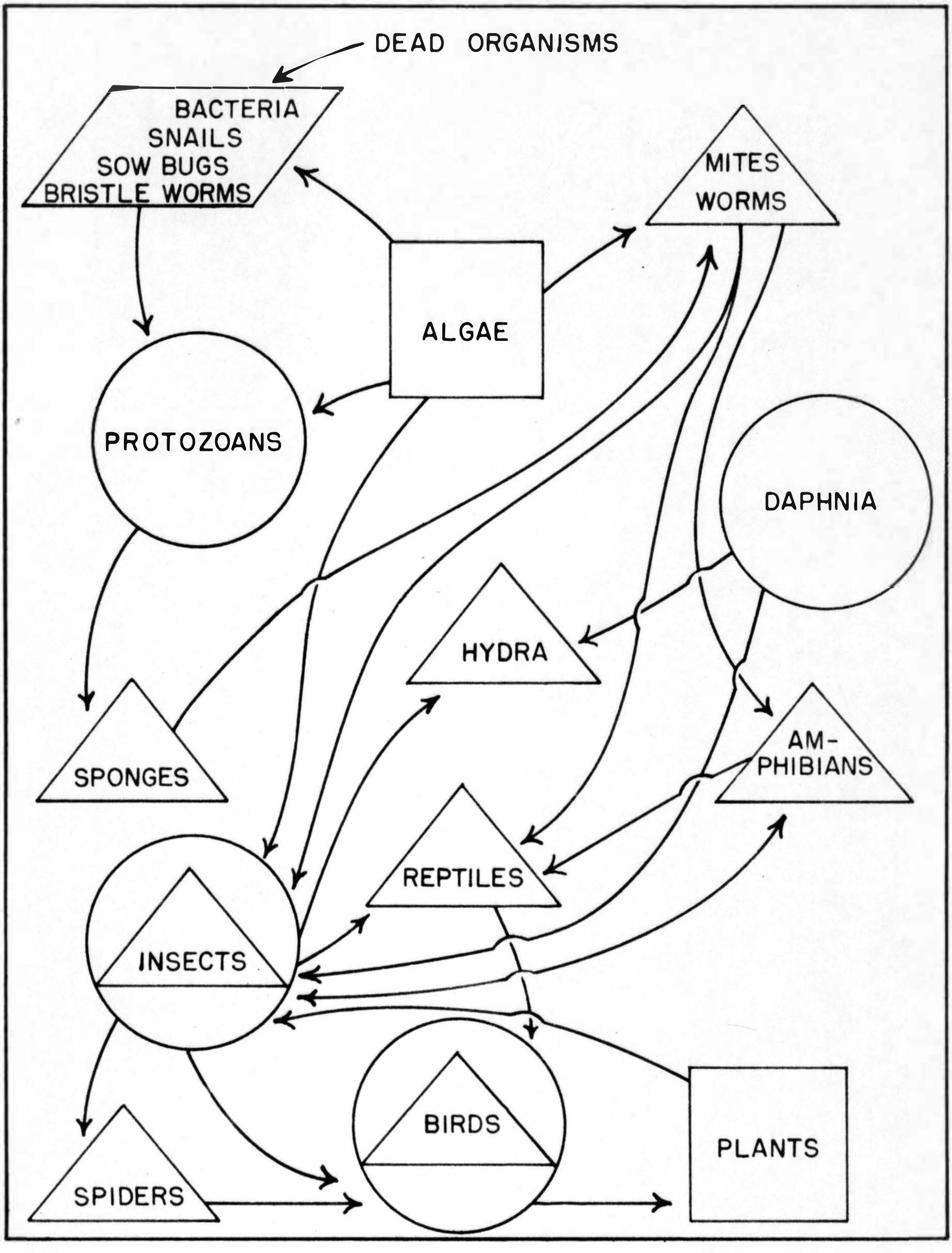

Figure 7. Probable food web at Fetch Pond.

producers converters consumers reducers

CHAPTER III

UNIT FOR NINTH GRADE BIOLOGY: STUDY OF AN AQUATIC COMMUNITY

I. OBJECTIVES

1. To enable each student to engage in a series of biological experiences which will enable him to interpret his environment and thus increase his awareness of and ability to analyze conservation problems.

2. To help each student gain an understanding of the following principles:

   (1) No organism lives in isolation: each organism is a part of a living community where its life is intimately related with the lives of a great many other organisms.

   (2) Organisms have special adaptations for respiration, food-getting, reproduction, locomotion, and survival through seasonal changes.

   (3) Organisms survive by competition and unconscious cooperation for food and space. In these activities, their roles in the food web may be as herbivores, carnivores, symbionts, saprophytes, parasites, or other specialized relationships.

   (4) Physical factors play an important role in a community, in establishing the limits within which organisms may exist.

3. To develop further each student's ability to note likenesses and differences, to discover relationships, and to develop skills in scientific observation and thinking.

II. METHODS

Understanding the Community Idea and Developing an Ecological Vocabulary.

Following a class discussion centered around a textbook assignment dealing with ecological principles, the question should arise, "What is ecology?" This will offer the teacher an opportunity to guide the class in planning an ecological study.

It is best to begin this study with a brief analysis of a natural community familiar to the students. A woods in which the children have played or hunted might be a good choice. The teacher may then divide the class into three groups with specific assignments: Group I will study the floor of a forest near their homes, make a list of living and non-living objects observed in the area, and bring in specimens which can be obtained without difficulty or damage to the area visited; Group II will make a similar observation of the shrub level of the forest; and Group III will investigate the tree level in a similar manner.

The class session following this assignment may terminate in the construction of a model of a forest community. If a black-board list is compiled of all

objects observed and collected in the forest community, the teacher may ask each student to copy the names of five of the living and five of the non-living objects from the list and to determine the relationships of these objects to the forest community.

During the next class period, the following ecological terms should be explained: producer, herbivore or converter, carnivore or consumer, omnivore, and reducer. The class may organize its list of living organisms, both observed and collected in the forest community, in columns headed with names of these foodroles.

The teacher may now suggest that the class study a different type of natural community, a pond, located near the school.

Taking the Preliminary Field Trip.

The students are now ready to take their preliminary field trip, Trip A, to survey sites which the teacher has already found to be the sites most practical and safe for students to study. Perhaps the students will want to sketch the area to be studied and to ask questions concerning the plants and animals which they observe in this area.

Seeing Films and Learning to Measure Physical Factors.

With the students' curiosity aroused, the teacher may show the following three films: Pond Life,[10] Life in a Pond,[11] and Pond Insects.[10] These films supply background information on aquatic life.

Before taking any of the field collecting trips, it is necessary to assemble the equipment needed for securing specimens, to acquaint students with the aquatic data sheets, and to discuss the procedure for measuring and recording physical factors. The physical factors to be recorded are listed on the aquatic data sheet. (See page 39)

Because a measurement of meteorological data such as sky coverage, clouds, surface wind, present weather, and light conditions can be approximated by the human sense organs, the only instruments necessary to obtain the information for the aquatic data sheet are a watch, a thermometer, a barometer, a yard stick, and two water sample bottles (100-150 cc capacity each). The chemicals

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[10]Encyclopaedia Britannica Films, Inc.

[11]Coronet Instructional Films

and the instructions for using them are listed on the form, Directions for Oxygen Determination--Winkler Method (see page 40).

AQUATIC DATA

State:________________ County:________________________

Locality:____

Drainage:____

Date:_________________ Sky coverage:__________________

Time of Day:__________ Clouds:________________________

Surface Wind:__________________

Present Weather:_______________

Air Temp.:_____________________

Barometric pressure:___________

Humidity:______________________

	SITE I	SITE II	SITE III
Water depth	________	________	________
Water temp.	________	________	________
at ________ inches		________	________
O_2 conc.	________	________	________
Light at surface	________	________	________
Time of day	________	________	________

SPECIMENS SPECIMENS SPECIMENS

DIRECTIONS FOR OXYGEN DETERMINATION, WINKLER METHOD

Field Work

1. Fill O_2 sample bottle (100-150 cc.) without bubbling.
2. Add 10 drops of manganous sulfate solution ($MnSO_4$).
3. Add 10 drops of KOH-KI solution.
4. Put top on bottle. Mix with 3 wrist motions.
5. Wait 1 minute. Take out top.
6. Add 15 drops of conc. sulfuric acid (H_2SO_4).
7. If a trace of O_2 is present water turns yellow.
   If O_2 is abundant water turns bright orange.
   If no O_2 is present water remains clear.

Laboratory Work

1. Place exactly 100 cc of yellow or orange sample in Erlenmeyer Flask.
2. Add 5 drops of fresh starch solution to contents of Erlenmeyer Flask. This will turn water a bluish color.
3. Fill burette with sodium thiosulfate solution, N/40 (Hypo). Read the burette and record as First Burette Reading.
4. Titrate by adding Hypo to the flask, drop by drop, until all color disappears from solution.
5. Record Second Burette Reading.
6. The difference between the second burette reading and the first burette reading is the ppm of O_2 in the water sample.

Second Burette Reading:______

First Burette Reading:_______

O_2 ppm:______

Site_____ Date_______ Field Trip_____

Taking Field Trips for Collecting Specimens.

If the teacher has about twenty-one students, it is a good plan to divide them into three groups. Each group of seven members may work at a separate site in order to keep out of each other's way.

Each of the seven team members may be assigned a letter of the alphabet from A through G, and the following duties may be assigned to the letter-holders: A's can obtain and record meteorological data, B's and C's can collect two water samples for oxygen determination from each site, D's and E's can observe and collect plant specimens, and F's and G's can observe and collect animal specimens. These duties may be rotated on each field trip to enable each class member to perform all four duties during the series of four field trips. The teacher, because of the safety factor involved, should transport all chemicals and equipment for treating water samples at the collecting sites.

Four collecting trips, Trips B, C, D and E, may be planned with laboratory periods following each trip. (The reader will recall that Trip A was a preliminary trip.) Trips B and C can be general collecting trips followed by laboratory periods during which the collected

specimens, kept alive in large classroom aquaria and large glass jars, will be studied and identified. Trip D may be devoted to collecting aquatic material which will be studied under the microscope. This aquatic material will introduce the students to the microscopic life. Before starting Trip D, the students should study the microscope and see two films, Paramecium,[12] and Protozoans.[13] Reading assignments can be given and class discussions on microscopic life may be held. The final field trip, Trip E, can be devoted to collecting specimens from the mud areas on the pond bottom. This trip can be followed by laboratory studies which will include identification of some of the organisms which were collected.

Organizing Observations.

Each student should organize his own observations and draw conclusions concerning the pond community. The activities to help students organize and summarize their experiences may include further study of classification, compiling lists of species for each site, drawing strati-

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[12]United World Films, Inc.

[13]Encyclopaedia Britannica Films, Inc.

fication maps showing not only the species and their food roles but also their habitat selection at each site, setting up a probable food web for the aquatic community studied, and making and playing an ecological role drill game.

Instructions for making and playing the game: Cut out enough (3" X 2") pieces of cardboard to make five decks of fifty-two cards, one for each organism. On each card draw a picture of an organism found in the pond and print its name below its picture. Next, cut from colored construction paper enough (3" X 2") strips so that each class member has one red for reducers, one green for producers,one yellow for herbivores, and one blue for consumers. Now the class is divided into groups of four. Twelve cards are dealt to each player. The caller names the organisms of the pond community. As he calls the name of an organism, the player holding a card bearing that name lays the card on the colored strip indicating the organism's food role. The first player to rid his hand of cards is the winner. In order to prove that he is the winner, he must call back the names of his organisms and state their food roles to the caller.

A final evaluation activity may be a quiz on principles and information studied. This may include questions such as:

1. What does the term "ecology" mean?
2. Briefly describe the aquatic community which we have studied.
3. What advantage is there in studying a whole community rather than studying one or more organisms in detail?
4. Name two plants from the aquatic community studied and state two ways in which the plants are similar.
5. Name two animals from the aquatic community studied and list two ways in which the animals differ.
6. What taxonomic group of animals were predominant at the aquatic community studied?
7. What could be a reason for the difference in oxygen concentration at the different sites?
8. What have you learned in the study of this aquatic community that should make you a conservation-alert individual?

The above questions will require the student to relate items of information rather than simply recall them.

III. ATTAINMENT OF OBJECTIVES

It is difficult if not impossible to be certain that all of the objectives of a unit of study have been met.

However, it is desirable to analyze the series of planned experiences to find out whether they are consistent with the objectives.

The whole series of experiences, field trips, laboratory and discussion sessions should contribute to the objective of helping the student interpret his environment. So too, the total experience should improve the student's skills in observation and scientific thinking.

Experiences designed to teach specific principles, such as, Principle 1 (No organism lives in isolation: each organism is a part of a living community where its life is intimately related with the lives of a great many other organisms), and Principle 2 (Organisms have special adaptations for respiration, food-getting, reproduction, locomotion, and survival through seasonal changes), were these:

(1) Field trips where organisms were observed in their natural environments.

(2) Laboratory sessions for observing the special adaptations of live specimens.

(3) Viewing films which show activities in a pond community.

Experiences planned to teach Principle 3 (Organisms survive by competition and unconscious cooperation for food and space.) were:

(1) Drawing stratification maps which show food role and habitat selection of species.

(2) Diagraming the probable food web of the aquatic community.

(3) Making and playing an ecological role drill game.

Experiences to teach Principle 4 (Physical factors play an important role in a community, in establishing the limits within which organisms may exist.) were:

(1) Compiling aquatic data sheets in which physical factors as well as lists of species collected at each site were recorded.

(2) Holding classroom discussion and laboratory periods after each field trip.

Because conservation problems are ecological problems, this and any other ecological study should contribute to the student's ability to analyze conservation problems. The student's increasing awareness of problems will, of course, depend on the teacher's knowledge and awareness.

IV. LIST OF MOTION PICTURE FILMS USED IN THE UNIT

<u>Pond Life</u>. Encyclopaedia Britannica Films, Inc.

<u>Life in a Pond</u>. Coronet Instructional Films

<u>Pond Insects.</u> Encyclopaedia Britannica Films, Inc.

<u>Paramecium.</u> United World Films, Inc.

<u>Protozoans.</u> Encyclopaedia Britannica Films, Inc.

V. LIST OF REFERENCE BOOKS USED BY STUDENTS

Barrows, W. B.
1912 Michigan bird life. Michigan Agricultural College, Lansing, Michigan. 822 pp.

Buck, Margaret Waring
1958 Pets from the pond. Abingdon Press, Nashville, Tenn. 72pp.

Buchsbaum, Ralph
1953 Animals without backbones. The University of Chicago Press, Chicago 37, Illinois. 504 pp.

Clark, A. H.
1948 Animals alive. D. Van Nostrand Co., Inc., New York 3, N. Y. 472 pp.

Dodge, Ruth A.
1959 Elements of biology. Allyn and Bacon, Inc., Chicago, Illinois. 740 pp.

Goetsch, Wilhelm
1958 The ants. The University of Michigan Press, Ann Arbor, Michigan. 169 pp.

Heinroth, Oskar and Katharina
1958 The birds. The University of Michigan Press, Ann Arbor, Michigan. 181 pp.

Life Editorial Staff and Lincoln Barnett
1956 The world we live in. Simon and Schuster, Inc., New York, N. Y. 216 pp.

Morgan, Ann H.
1930 Field book of ponds and streams. G. P. Putnam's Sons, New York, N. Y. 448 pp.

Morris, Percy A.
1945 They hop and crawl. The Ronald Press Co., New York, N. Y. 253 pp.

Pearson, Gilbert T. (Editor-in-Chief)
1936 Birds of America. Garden City Publishing Co., Inc., Garden City, N. Y. 289 pp.

Platt, Rutherford
1947 Our flowering world. Dodd, Mead and Co., New York City, N. Y. 278 pp.

Portmann, Adolph
1959 Animal camouflage. The University of Michigan Press, Ann Arbor, Michigan. 111 pp.

Raymond Foundation (Staff Members)
1952 The hydra. Museum Stories, No. 229. Chicago Natural History Museum, Chicago 5, Illinois.
1954 Duckweeds. Museum Stories, No. 263. Chicago Natural History Museum, Chicago 5, Illinois.
1959 Swamp dwellers. Museum Stories, No's. 23, 41, 140-148. Chicago Natural History Museum, Chicago 5, Illinois. Unpaged. Illus.

Shuttlesworth, Dorothy, and SuZan Noguchi Swain
1959 The story of spiders. Garden City Books, Garden City, N. Y. 55 pp.

Teale, Edwin May
1948 Days without time. Dodd, Mead and Co., New York, N. Y. 283 pp.

Usinger, Robert L. (Editor)
1956 Aquatic insects of California. University of California Press, Berkeley, California. 508 pp.

Ward, H. B. and Whipple, G. C.
1918 Fresh-water biology. John Wiley and Sons, Inc., New York, N. Y. 1111 pp.

Zim, Herbert S.
1947 Plants. Harcourt, Brace and Company, New York, N. Y. 398 pp.
1950 Frogs and toads. Wm. Collins Sons and Co., Canada Ltd. 58 pp.

CHAPTER IV

NINTH GRADERS STUDY A POND COMMUNITY

The ninth graders of White Pigeon High School studied Fetch Pond during the fall of 1960. Their unit of study proceeded according to the plan described in Chapter III.

I. INVESTIGATING THE BIOTIC COMMUNITY

Understanding the Community Idea and Developing an Ecological Vocabulary.

On the first three days following fall enrollment, the class was discussing the meaning of biology, life processes of organisms, and kinds of habitats. The question arose, "What is ecology?" No one seemed to know, but the students found the following definition in their text: "Ecology (eh-kol-uh-jee): the study of the relationship between living things and their environment."[14] The students indicated a lack of understanding, and the teacher asked, "Would you like to make a study in ecology?" A resounding, "Yes, but how do we do this?"

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[14] Ruth A. Dodge. 1959. Elements of Biology. Allyn and Bacon, Inc., Chicago, Illinois. p. 694. (This is the textbook for the course.)

was the answer.

The teacher then asked each member to visit a forest or wooded area before the next class session. This was an easy assignment because half of the class members live in cottages in forests around lake areas, or in homes bordering wooded regions. The class was divided into three groups with specific assignments: Group I was to study the floor of the forest for living and non-living objects; Group II was to observe the shrub level; Group III was to investigate the tree level. Each student was asked to make lists of objects in the area studied and to bring in specimens which could be obtained without difficulty from the site studied. The next day a wooden box, two feet by three feet by three inches in depth, and a pail of forest soil were placed on the demonstration desk. One of the students volunteered to pour the forest soil into the box. The Group I observers listed on the blackboard the objects which they had seen on the ground and placed their collected specimens on the soil in the box. One of the students placed a gall on the soil. The gall was identified by the teacher without explanation, and no one knew what it was. Groups II and III proceeded to report in a similar manner. A miniature forest appeared

in the box as a result of the combined efforts of the three groups. Then each student received an assignment sheet for his listing of forest-community plants, animals, inorganic objects, and the effects which these exert in the community. In addition, each one was asked to write his own brief definition of a forest community and was also asked to find out what galls are.

On the following day, the class viewed the miniature forest community which they had constructed. The teacher asked who would like to read his definition of a forest community. Three students responded, and all agreed that a community consists of organisms living together. Next came the question, "Do you think each organism in this forest could be placed in a special list according to the role it plays in the food web of the community?" Most of the students answered, "Yes," and the teacher made four columns using the ecologist's terms for the food roles these organisms play. There could have been a fifth column for the omnivores which consume both plant and animal material. Four columns in fluorescent chalk, which appears white except under ultraviolet light, were made: Producers, Herbivores or Converters, Consumers (parasites and carnivores), Reducers (transformers,

scavengers, and decomposers). The following lists were placed on the blackboard:

Food Roles in the Forest Community

Producers (turns green under ultra-violet)	Herbivores or Converters (turns yellow under ultra-violet)	Consumers (turns blue under ultra-violet)	Reducers (turns red under ultra-violet)
Ferns	Caterpillars	Turtles	Snails
Fennel	Crickets	Snakes	Earth-worms
Hepatica	Ants	Toads	Fungus
Moss	Flies	Frogs	
Oak shrubs	Walking stick	Cardinals	
Raspberry twigs	Squirrels	Miscellaneous birds	
Oak trees			
Shellbark hickory trees			
Sumac			
Maple			
Beech			

Then the room was darkened, the ultraviolet light was turned on, and the colors appeared. One of the class members immediately stated that green is composed of

yellow and blue. The green plants are the primary producers upon which the herbivores feed, but the consumers in turn feed upon the herbivores. Red was the color used for the reducers which decompose matter into constituents used by the producers.

The class through their experience with the woods community was acquainted with the natural community idea and with a beginner's ecological vocabulary. Upon the teacher's suggestion that the class might study a different type of natural community, plans were made to visit a pond located near the school.

Taking the Preliminary Field Trip, Trip A.

The class members, wearing boots, and carrying pencils and clipboards with plain typing paper, walked to the east side of the football field, climbed over the remains of a broken-down fence, stood on the hillside, and looked at Fetch Pond. There followed a short discussion of these problems: What type of community is this? What kind of habitat is here? How deep do you think the water is? How do you know the approximate depth? Answers came rapidly that this pond community is an aquatic habitat with a depth of approximately three feet. This is indicated by the rooted lily pads in the middle of the pond. The twenty-one members of the class

observed the poison ivy growing on the ground and on the shrubbery on the north side of the pond and agreed to avoid it by going westward. They then walked around the pond to see if any other barriers would prevent their access. While walking, the students found the three sites which were studied by the teacher in her summer survey of the community. These are the only places of easy access to the pond water. Then the students retraced their footsteps to the hillside where they could look at and make sketches of the pond. The students asked for the names of the large plants so they could label their drawings.

Seeing Films.

The next school day the students viewed the films, *Pond Life*,[15] *Life in a Pond*,[16] and *Pond Insects*.[15] The information about the mayfly which was presented by the last film was used to initiate an assignment. The film showed that a mayfly has six legs, is a herbivore, and is consumed by fish. Although it may seem possible for the mayfly nymph to use its legs to crawl

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[15]Encyclopaedia Britannica Films, Inc.

[16]Coronet Instructional Films

out of the pond to find green leaves upon which to feed, it does not leave the pond. The teacher then assigned this problem for over-night study: "What makes a mayfly nymph remain in the pond where it is apt to be consumed by fish?" Three students handed in papers stating that they had observed respiratory gills on the mayfly nymphs in the films. Therefore, they reasoned, the mayfly nymph must remain in the water if it is to live. One of the better students said that insects lack reasoning power and are guided wholly by instinct. All of these answers showed analytical thinking.

Learning to Define and Measure the Physical Factors.

On the next day, five students took turns reading their lists of the physical factors important in an aquatic community. They had been asked to list the physical factors which they considered important and to state *how* each factor is important. The class then compiled the following list of physical factors which they considered vital in an aquatic community:

(1) Temperature: Some organisms will fail to reproduce or die if the temperature is too low, just as some will migrate or die if it is too high.

(2) Moisture: All living organisms must have water, because this is an essential component of protoplasm.

(3) Light: Green plants have to have light to carry on photosynthesis. Light is also necessary for organisms to see.

(4) Air: Oxygen is used by all living organisms in the process of utilizing food as a source of energy.

Aquatic Data sheets (see page 39) were given to each student. As a part of the practice in observing and recording physical factors, each class member filled in all information on the Aquatic Data sheet down to the item labeled "clouds." Then the following activities took place. Cloud types were reviewed. Surface wind recording was discussed. It was mentioned that past weather included any precipitation that had taken place in the last two to twenty-four hours while present weather included the weather conditions of the present hour. Next the air temperature of the room was measured at waist level with a Fahrenheit mercury thermometer. The barometric pressure was measured by reading the mercury barometer and correcting for altitude and temperature. The relative humidity was taken from the humidiguide which can be carried on field trips. The method of measuring water temperature was not only discussed but the water temperature was actually measured in a water-filled sink in the demonstration desk. Since

no light meter was available, the class decided that this factor would be recorded as either dark, fair, or sunny, as it appeared to the human eye.

The students had no idea how to measure the oxygen content of the water. Therefore, the teacher distributed directions for oxygen determination (see page 40) and demonstrated the procedure.

<u>Taking Field Trips for Collecting Specimens.</u>

The principal purpose of field trips B and C, in addition to measuring and recording data on physical factors, was to collect samples of the macroscopic organisms from the study sites at the pond.

During the laboratory period following field trip B, the teacher distributed keys for identification of insects, and the class as a group followed through the key to identify the backswimmer. Over thirty specimens of backswimmers had been collected, and each member of the class had a specimen for examination. After field trip C, individual reports, concerning organisms collected and identified, were assigned to class members on a voluntary basis. Copies of the pamphlets,

Swamp Dwellers,[17] and Duckweeds,[17] were distributed as outside reading assignments.

Time was taken in our next four class sessions to observe animal habits, and to prepare for field trip B which was to deal with collecting microscopic material from the pond.

While observing our schoolroom aquaria, we noticed that in the large aquarium, the water scorpion was catching backswimmers and sucking the body fluids from them. The diving beetles carried air bubbles with them wherever they went. In the small aquarium, one of the tadpoles was being attacked by parasitic leeches. This latter observation induced the class to remove all the leeches from the small aquarium into a gallon jar which contained pond water and had a muddy bottom. One student said, "A person can see food roles in the aquaria. The tadpoles are feeding on the green algae, and the leeches are feeding on the tadpoles. The backswimmers are consuming matter at the surface of the water, and the water scorpion is catching backswimmers

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[17]Raymond Foundation (Staff Members) "Swamp Dwellers" and "Duckweeds," Chicago Museum of Natural History, Museum Storybook No's. 23, 41, 140-148, 263; unpaged, illus. 1959.

and sucking the body fluids from them." Another discovery was that of three green Hydra attached to the sunny side of one of the jars filled with pond water. Upon passing the jar for individual observation, the students noted that the Hydra contracted into tiny spheres and dropped to the bottom of the jar, where they were difficult to see. Curiosity concerning this organism led to a student's reading and reporting on the symbiotic relationship of Hydra with unicellular algae, thus explaining the green coloring of the animal.

To prepare for field trip D, the class saw the filmstrip, The Microscope,[18] and followed this with a session of examining microscopes and determining their magnifying power. Reading references on the cell and protozoans in the textbook[19] were assigned. The class saw two films, Paramecium[20] and Protozoans[21] and held discussions concerning the cell and microscopic life in general. The teacher instructed the plant and animal

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[18]Visual Education Consultants, Inc., Madison, Wis.

[19]Dodge, op. cit., pp. 50-59, pp. 70-78.

[20]United World Films, Inc.

[21]Encyclopaedia Britannica Films, Inc.

collectors on field trip D to bring back gallon jars of water containing microscopic organisms from each site.

Two laboratory periods followed field trip D. During these laboratory periods, the members of the class made slides by using medicine droppers to transfer drops of the pond water to slides. The students studied the slides containing organisms from their respective sites. These were most enjoyable periods, and one of the students commented that he was certainly sorry that he had sold his own microscope. As the students had found that the living specimens moved so rapidly that it was difficult to study them in detail, they examined prepared slides of _Amoeba_ and _Paramecium._

On field trip E, the final field trip, the plant and animal collectors were instructed to bring back gallon jars filled to half their depth with mud, and filled for three inches above the mud with pond water. In the laboratory period which followed, the students shared the activities as follows: one student from each site stirred a pan of mud from the site with a glass stirring rod while he searched for macroscopic plants and animals; three members made slides from the mud which they examined under the microscope for plants and animals; and the

other three members of the team stirred the pond water into the mud to make slides of the water after the mud had again settled. Then the class compiled lists of organisms found in the mud.

II. ORGANIZING OBSERVATIONS AND EVALUATING THE STUDY OF THE AQUATIC COMMUNITY

Each student then set about compiling a list of specimens observed at the site assigned his group. Because students were asked to arrange lists in order from the simplest to the most complex phyla in each kingdom, it was necessary to discuss plant and animal classification. After the class session on classification, the teacher instructed the students to organize their lists. From the lists handed in by the students, the teacher compiled fauna and flora sheets for the total area of the pond and adjacent habitats. Each plant specimen was assigned a letter of the alphabet and each animal specimen was assigned a number for later use in reference to site maps. The lists were then returned to the students, and all were given a copy of the flora and fauna sheets.

The next task was that of drawing a stratification

map for each site, showing (1) food roles of organisms and (2) habitats of the organisms. The problem of drawing was simplified by the use of the assigned letters for plants and numbers for animals.

Then, working together, the students drew in colored chalk on the blackboard a diagram of the probable food-web in Fetch Pond. The members of the class asked if they might make smaller copies of the drawing for their individual folders on the unit.

To review the ecological role of each organism in the pond, the class made a game from cardboard and colored construction paper and played it. The rules for constructing and playing this game were given in chapter three.

Another use of the cards taught the interdependence of the organisms. Each class member drew a card from the game deck to obtain an organism's name. He was then told to write an essay on the topic: Alterations at Fetch Pond if All __________ Vanished. Each inserted in the blank the name of the organism on his card.

Next came a discussion period on the origin of Fetch Pond, its present role in the human-plant-animal

community, and its probable future role. Many of the students expressed a hope that Mr. Fetch would stop plowing the hill on the south side of the pond because erosion is carrying the topsoil into the pond.

As a final evaluation, the students were given the following test.

Biology Quiz on Fetch Pond Study

1. What does the term "ecology" mean to you?
2. Briefly describe the aquatic community at Fetch Pond.
3. What advantage is there in studying a whole community rather than studying a single organism in detail?
4. Identify this organism. (Backswimmer)
5. Is the organism in question four a consumer, reducer, herbivore, producer, or omnivore?
6. What is the name of this organism? (Dragonfly)
7. How does the organism in question six help man?

8.
9. In what two ways are the spotted newt and the grass frog similar?

10.
11. State two ways in which cat-tails and *Spirogyra* are similar.

12.
13. State two ways in which the above two plants are different.

14. What do snails, fungi, and backswimmers have in common?
15. What taxonomic group of animals were predominant at Fetch Pond?

16. What could be a reason that we found higher oxygen concentration at the sites on our last field trip than on our first field trip?

17. What have you learned in the study of Fetch Pond that should make you a conservation-alert individual?

18. What might Fetch Pond be like in fifty years?

19. What did you enjoy most in this study?

20. What did you enjoy least in this study?

CHAPTER V

EVALUATION AND SUMMARY

I. EVALUATION OF THE UNIT

Student Reactions.

When the students were asked during discussion and quiz sessions what they considered the most informative part of the unit, they answered: 1) observing the microscopic world of organisms from the pond, 2) going on field trips, 3) noticing ways organisms resembled one another, 4) seeing how different animals live, and 5) determining oxygen content of the water. When the students were asked what the least enjoyable part of the study was, a few stated that they did not like: 1) the task of using keys to identify specimens, 2) collecting mud samples, 3) killing insects, 4) compiling lists of flora and fauna, and 5) walking through scratchy weeds to the pond sites. Most students replied emphatically that they enjoyed everything done in the unit, and wished that we could go on with the study during the entire school year.

One student asked if he might study the regenerative capabilities of Planaria for the school science fair to be held in the spring. Other students asked if they could dissect some of the frogs taken from the pond, since the organs of a frog should be interesting to study, especially the stomach which might reveal the exact nature of the food consumed. Another member of the class asked if chemistry was anything like the titration exercise carried out to determine the oxygen content of the water, and added, "If it is, I'm surely going to elect chemistry."

The semester examination included a question asking each student to list five ways in which the unit in ecology studied at the beginning of the school year had added to his understanding of biology. This brought the following comments:

1. It helped me become better acquainted with more animals and plants. I know better now what more animals eat and how they live.

2. It showed that all plants and animals need each other to live. If one species of plant or animal were to die out, it would have an effect on the rest of the plants and animals. It also showed how man can upset nature's balance.

3. I discovered that there are many animals and plants too small to be seen with the naked eye. These microscopic organisms greatly affect our lives.

4. I now understand what metamorphosis means, as I

saw animals in the different stages of their life cycles.

5. Some of the vocabulary of biology, such as the term *symbiosis*, has real meaning after observing the green *Hydra*.

6. I observed just how much competition there is between animals in order to obtain food and stay alive. It helped me see the reason some must die that others might live in nature.

7. This study helped me like biology better, and I know that things I have read in books are true, because I have seen them myself.

8. By bringing back and keeping living specimens, we learned about the eating habits of many organisms.

9. I never knew before how a pond could have living things in it when there didn't appear to be any food around to eat.

10. I learned that organisms live in many places. Some are even in the mud as well as in the water and along the top of the ground and in the air.

11. I learned about some insects' adaptations, such as the gills of the dragonfly nymph for respiration.

12. It helped me to see both harmful and helpful insects, and to know which one is helpful. I won't kill it after this. I realize that most living organisms are important to mankind.

These students' comments are evidence that most of the objectives of this unit were attained by members of this ninth grade group.

Teacher Reactions.

The teacher noted that students of this age group

are especially interested in learning about interrelationships of organisms, and would gather around the large aquarium at the beginning of the class period to see if the water scorpion had captured another backswimmer. One student kept studying the jar containing green *Hydra* each period, and stated that he never would forget what symbiosis means.

Some students of this age group dislike the task of using keys to identify organisms. One boy volunteered to make a report on one of the aquatic insects collected at his study site, only later to awaken to the fact that he did not know what it was called. He asked the teacher to tell him its name and she informed him that he knew how to use the key. He immediately asked to borrow a pond handbook. Within five minutes he had thumbed through the illustrations, located the water boatman and stated with a smile that he liked to look for pictures which identify organisms, but disliked mutilating an insect to see if it had three or five tarsi. He said also that the picture method is faster, and leaves one with more time for reading about the organism's way of life.

The teacher enjoyed the work in this unit, as it

provided opportunities for the slow student, and at the same time enabled the bright student to become as deeply involved in the study as he wished. One of the gifted students later engaged in a study of the regeneration of tissue in *Planaria*.

II. SUMMARY

For the first time in the writer's six years of teaching experience, every student in a biology class passed not only a unit test but also the semester examination. This supports her belief that fifteen-year-olds can be more highly motivated by laboratory and field experiences than by textbook assignments and written examinations conducted in traditional fashion. The laboratory and field experiences served to stimulate the natural desire of these young people to comprehend the fascinating, living world. The study of aquatic ecology served to give them an introduction to this world in a combination of out-of-class and in-class experiences.

The methods which were used encouraged the students to think, to make observations and reach conclusions. It constituted a cooperative effort, with the students taking the initiative in activities, doing their own

thinking, questioning and concluding. One can hope that the method of reasoning employed in a unit of this type will set an example for the application of wisdom in daily life as well as in the study of science.

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