A COMPARATIVE STUDY OF THE EFFECT OF A TRADITIONAL AND A SPECIALLY DESIGNED COLLEGE COURSE IN BIOLOGY UPON CONSERVATION ATTITUDES

Thesis for the Degree of Ph. D.

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Eldon Eugene Whiteman

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This is to certify that the

thesis entitled

A COMPARATIVE STUDY OF THE EFFECT
OF A TRADITIONAL AND A SPECIALLY
DESIGNED COLLEGE COURSE IN BIOLOGY
UPON CONSERVATION ATTITUDES

presented by

Eldon Eugene Whiteman

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of the requirements for

Doctor of Philosophy degree in Fisheries and Wildlife

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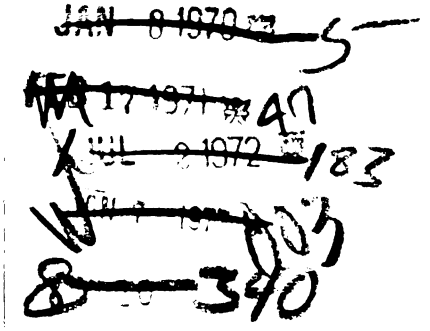

ABSTRACT

A COMPARATIVE STUDY OF THE EFFECT
OF A TRADITIONAL AND A SPECIALLY
DESIGNED COLLEGE COURSE IN BIOLOGY
UPON CONSERVATION ATTITUDES

by Eldon Eugene Whiteman

The purpose of this study was to ascertain if it was possible to change existing attitudes toward conservation concepts by exposing the student to conservation subject matter that becomes a part of the college freshman biology course.

Many aspects of attitudes have been studied but this investigation was concerned only with attitude change and the possibility of modifying attitudes with new experiences. Conservation educators have hoped that their teaching of the present-day facts established by the professional conservationist aid in helping the student formulate favorable attitudes, but little has been done to determine if this is actually the outcome.

The experiment took place on the Spring Arbor College campus during the 1963-64 school year. The second semester biology class became the experimental group while the first semester class served as the control group. A second control was also used, this being a biology class at Northwestern College, Orange City, Iowa.

The course taught to the experimental group included a specially prepared unit on conservation but the course taught to the two control groups did not include any conservation material.

The unit developed for the experimental group was general in nature and of five-weeks duration. Attitude goals were not included in the objectives of this unit as the writer was endeavoring to determine if the teaching of the fundamentals of conservation per se had any effect upon attitude changes.

An ecological approach was used and the four renewable resources, soil, water, forests and wildlife were presented. The study of these resources was preceded by an introduction to the population crisis and its effect upon the natural resources base. In addition to presenting the lectures on renewable resources several other teaching techniques were employed such as handout materials, a visiting specialist, independent study, visual aids and a one-day field trip.

The instrument chosen for measuring attitude change was a Likert-type scale developed by Dr. George M. Laug of New York State University, College of Buffalo. The students in both the control and experimental groups were tested at the beginning and again at the termination of the course to determine if any change in the class mean (attitude measurement) had taken place as a result of the unit. The study was not concerned with individual diagnosis but was involved only with a study of the difference between means of the groups. The "F" test was used to establish homogeneity of variance for uncorrelated groupings and the "t" test was used to ascertain the

significance of difference between means. The 1% level of confidence was adopted as the criterion for significance with the 5% level being considered of questionable significance.

Following are the major conclusions from the study:

1. There was a difference of 0.29 points between the scores of the Spring Arbor experimental and control groups on the means of their pre-test, a difference not statistically significant.

2. There was a change in a positive direction significant at the 1% level of confidence, in the attitudes of the experimental group.

3. No statistically significant change in attitudes occurred in either of the two control groups.

4. Sex was not a statistically significant factor in attitude change.

5. The rural students appeared to have been influenced by their place of residence more than the urban and suburban.

6. Having had a course in high school geography had no significant effect upon attitudes.

7. 4-H training appeared to have some value as these students did significantly better on the pre-test situation than did the non-4-H students.

8. Summer camp experience appeared to have some value, as these students scored higher, as revealed in pre-test comparison.

9. Scouting had no statistically significant effect upon attitudes at the time of entry or termination of the course.

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CHAPTER I

INTRODUCTION TO A COMPARATIVE STUDY OF THE EFFECT OF A TRADITIONAL AND A SPECIALLY DESIGNED COLLEGE COURSE IN BIOLOGY UPON CONSERVATION ATTITUDES

I. Introduction

The peoples of the world are slowly awakening to the fact that a population crisis is now upon them. Population growth has shifted from a wave-like pattern of gains and losses to a steady and upward trend.[1] This sudden increase is no doubt due to several factors, but the most important ones appear to be the results of modern medical science. Disease is being brought under control and better sanitation measures are being put into practice throughout the world.

It has taken many centuries for man to reach his present numbers but according to a study made by United Nations Educational, Scientific and Cultural Organization (UNESCO) the world human population will double within the next forty years.

> World population is now about at the 3,000 million mark. It increased by over 500 million in the 1950 decade. It is estimated to increase by about 600 million in the 1960 decade, or at the rate of about 60 million persons per year; at this rate, world population will double in about forty years - reaching 6,000 million before the year 2000. And with falling death rates in many areas of traditionally high birth rates, the population in the year 2000 could conceivably exceed this figure by 1,000 million.[2]

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[1] United Nations Office of Public Information, Population and Food Supply, August, 1962, p. 2.

[2] Ibid., pp. 11-12.

If it should occur, this could well spell a miserable existence for most of mankind. With little question the world would witness more famine, malnutrition, stress, pollution of the environment and a strain upon all natural resources.

Those living in the United States are not immune to this problem as the vital statistics show that our population doubled between the years of 1900-1950.[1] In the past we have considered ourselves as a nation of unlimited space and for several centuries we have provided a home for the surplus of Europe. Population is a new problem to our country and few can yet comprehend what may be the outcome.

The question that arises from these facts is: Do we have the resource base to take care of this added burden and maintain our present standard of living? Most are willing to remain in a state of apathy and believe that we need not conserve resources as our present day know-how will supply us with substitutes when our resources become exhausted. Mudd does not agree with this philosophy and states that science and technology may not be able to rescue man.[2]

In addition to the population strain upon resources a second factor is making its appearance. This is the fact

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[1]Samuel Ordway, Resources and the American Dream. (New York: The Ronald Press, 1953), p. 12.

[2]Stuart Mudd, ed., The Population Crisis and the Use of World Resources ("World Academy of Art and Science," No. 2: Bloomington, Indiana: Indiana University Press, 1964), p. 25.

that the backward nations are awakening and demanding a higher standard of living than the simple existence which has been theirs in the past. In their demand for things, industrialization of these nations will be called for. Then the raw materials will no longer be exported to the European and American markets but will be preserved for their own production.

The above facts indicate that conservation education is more important today than at any time in the history of our nation. In recent years the trend in the United States has been a movement from the farm to the city, so we are becoming farther removed from the soil.

> It is not good that a generation lose sight of the fact that the food they eat has to be grown and that from the land comes clothing, shelter, raw material for industry and our most wholesome kind of recreation. We cannot expect much of this understanding to come from parents because they too have become detached from the land and fundamental realities that make this country strong. If it is to become a part of the minds and consciousness of young people, it must come through the school.
>
> Wise use of our resources cannot be left to other agencies, bureaus and departments. In a democracy people must know and understand what our natural resources are, what measures are necessary for their intelligent use and what programs are in effect to accomplish this end. This is not a reflection on the public agencies and private enterprises that are engaged in the management of our resources -- it is simply that we, the general public, must know more about these resources and their use if we are to support constructive programs.[1]

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[1] Paul Barrett, Conservation, A Responsibility of Our Schools, Conservation Bulletin No. 5, Vol. 2 (East Lansing: Michigan State College, 1953), p. 1.

> The schools have a great responsibility and a great opportunity to serve our country through educating our future citizens to conserve and use our resources wisely.[1]

There is a definite need for a sound well-rounded conservation education program in our schools of today. Most enlightened educators would no doubt agree with Fersh when he states, " . . . education for dealing with our resources is one of the most urgent problems that mankind faces today."[2]

Work on the elementary level is to be commended, but there appears to be little follow through at the high school and college levels. At the present time the majority of college students receiving conservation education other than those being technically trained, are those taking inservice or preservice training for teaching or occasionally those biology majors taking a course in conservation. Thus a very low percentage of college students are receiving this type of training.

Since these college trained persons are our leaders of tomorrow it might be well to consider how we may reach all of the freshman students with this information.

One possibility could be the introduction of a unit on resource-use in the freshman biological science course.

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[1]George L. Fersh, Focal Responsibility of Our Times, An address delivered at the Convention of Texas Soil Conservation District Supervisors, Galveston, Texas, January 13-15, 1960 (New York: Joint Council on Economic Education), p. 1.

[2]George L. Fersh, A Design for Learning, An address delivered at the Michigan Leadership Conference, Ann Arbor, Michigan, January 23, 1960 (Ypsilanti: Eastern Michigan University), p. 5.

The objectives of such a unit would be to teach the basic fundamentals and to stimulate the students to an interest in conservation problems. This type of training should activate them toward their civic responsibilities, as intelligent decisions cannot be made without some knowledge of the problem in question.

In addition to supplying the student with facts, such a course should also cause him to formulate positive attitudes toward conservation concepts. Most educators today believe that educational procedures and course content can and do change attitudes.[1]

With the resource problems that face us today, poor attitudes of the past can no longer be tolerated. Education in the future must be concerned with whether it is producing types of attitude patterns that are desirable.

II. History of Conservation Instruction at Spring Arbor College

Spring Arbor is a church-related college which operates under the auspices of the Free Methodist Church. The college is accredited as a four-year institution by the North Central Association of Colleges and Secondary Schools, the Michigan College Association, The Council for the Advancement of Small Colleges and a charter member of the Association of

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[1] H. H. Remmers and N. L. Gage, Educational Measurement and Evaluation (rev. ed.; New York: Harper and Brothers, 1955), p. 359.

Free Methodist Colleges.

The college is owned and governed by a Board of Trustees which includes both church representatives and laymen. While the college is affiliated with a religious denomination, it is non-sectarian and students from many faiths are in attendance.

Spring Arbor College is located seven miles southwest of Jackson, Michigan on M-60. The students who attend are mostly from the states of Michigan, Pennsylvania, Ohio, Indiana and Illinois.

The heart of the curriculum at Spring Arbor College is the general education program. It is the opinion of the writer that conservation should be a part of such a program and the administration agrees with this philosophy giving its approval of such an addition to the curriculum.

In the fall of 1954, a one-semester two-credit course entitled "Conservation of Natural Resources" was added to the offerings of the biology department. Since that time the subject has been taught during the even years with an average enrollment of thirty students.

The text used until the fall of 1962 was "This Is Our Land."[1] At that time, after reviewing several new books, a change was made and "Environmental Conservation"[2] was

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[1] E. G. Cheyney and T. Schantz-Hansen, This Is Our Land (Saint Paul: The Webb Publishing Co., 1950).

[2] Raymond F. Dasmann, Environmental Conservation (New York: John Wiley & Sons, 1959).

chosen to replace the former book. The work in the text was supplemented with visual aids and an occasional guest speaker.

Each year since the initiation of this course, new books have been purchased for the library and the holdings are now adequate for teaching a course in conservation. To introduce the literature in this field, each student was required to prepare a paper on some phase of conservation making use of the library reference materials.

A one-day field trip was taken each time the course was offered and such places as the W. K. Kellogg Bird Sanctuary and Forest Area were used. On several occasions the classes also visited the Wolf Lake Fish Hatchery.

In the past little conservation matter has been injected into the general biology course offered at the freshman level. However, in the scheduling of films one or two good general conservation films were usually included.

In the fall of 1963 a new curriculum called "The Christian Perspective in the Liberal Arts" was introduced.

> . . . this curriculum is designed to introduce the student to serious learning in the liberal arts and to encourage him to relate his knowledge to the Christian philosophy of life. Consequently, emphasis is placed upon the scholarly approach to ideas in the liberal arts, the analysis of critical issues that arise out of study, and the integration of these ideas and issues with the Christian perspective.[1]

During the freshman year the student is required to

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[1]Catalog of Spring Arbor College, 1963-64, p. 13.

take communications, physical and biological science, social science, Biblical literature and Christian doctrine. This course of study continues into the sophomore year with advanced courses in literature and fine arts, psychology, sociology, philosophy and ethics.

Between semesters the sophomore student participates in "The Exploratory Experience" as he spends one week in the home of an individual who is successfully involved in the same career that the student intends to pursue.

During his senior year the student registers for the last course in the required sequence, the senior seminar.

> . . . in the senior year after the student has completed most of the requirements in his major field of concentration. This "Senior Seminar" is an opportunity for the student to integrate his total college learning through discussion sessions, research writing and independent reading.[1]

In the development of the new curriculum all instructors involved were encouraged by the administration to carefully analyze their present courses and determine what improvements could be made. This gave the writer, who for seventeen years has taught the biology courses, the long desired opportunity to revise the present biology course to include a five-weeks unit on conservation of natural resources. By this means practically all graduating seniors will have some exposure to a resource study.

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[1] Ibid., p. 14.

III. Statement of the Problem

This study proposed to find if it is possible to change significantly the attitudes of the college freshman biology student toward conservation concepts by exposing him to a five-weeks general unit on the subject.

It is the opinion of the writer that every person has a stake in natural resource conservation. Since many of our college prepared young people will be called upon to fill the positions of leadership in the future it is especially important that they do not graduate ignorant of, or with undesirable attitudes toward, our present day resource problems.

An example of an improper attitude is the one the public has toward the predator. Due to a lack of knowledge or misinformation, it is commonly believed that predacious birds and mammals are man's enemy and they should be destroyed. This and numerous other erroneous attitudes offer a challenge to educators to review our present day programs and determine if it is possible to reach a greater number of students with at least the fundamentals of resource conservation and to introduce them to the literature on this subject.

Many educators believe that the teaching of conservation facts will help in formulating good attitudes but very little investigation has been carried on to determine if this is true.

IV. General Plan of the Study

In formulating plans for this study, the decision was made to use the freshman biological science class at Spring Arbor College. A four-credit one-semester course, meeting for three lectures and one double laboratory period per week was started. This made approximately seventy students available each semester for purposes of this study. The first-semester students were the control group and the course was taught to them in the conventional way with no instruction pertaining to conservation. The second-semester class then became the experimental group and their course included a five-week conservation unit.

The course was totally revised for the second-semester group utilizing the following three major divisions:

I. The Nature of Biological Science - (two-weeks)
II. The Nature of Life - (eight-weeks)
III. Perpetuation of Life and Resources - (five-weeks)

The last week of the semester was the week of final examinations.

In the third unit the class was first introduced to the population crisis and its implications. This was followed by basic ecology and a survey of the four renewable resources, soil, water, forest and wildlife, with a major emphasis being given to the topic of soil.

Since an ecological appraoch was desired, "Environmental Conservation"[1] was chosen as the textbook.

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[1]Raymond F. Dasmann, op. cit.

In the planning of this unit it was believed that the course would be more effective if various teaching techniques were employed. The lectures were supplemented by handout materials especially prepared for the experimental class; independent reading in the library; visual aids; one outside speaker and one all day field trip. During the study the bulletin board in the laboratory carried current material pertaining to conservation.

During both semesters the attitude test was administered at the beginning of the course to determine the attitudes of the students before being exposed to the subject matter, and again at the end to check for possible changes. Both semesters were taught by the writer and the material was presented objectively as fact. The instructor did not knowingly teach with the statements from the measuring instrument in mind.

The attitude scale used was the one developed by George Milton Laug from the State University College at Buffalo, New York.[1] This attitude scale was the Likert type. The same scale was used for testing of both the control and the experimental groups.

A study was also made with a second control group at Northwestern College, Orange City, Iowa. This college was selected because it is about the same size as Spring Arbor College and has a similar program.

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[1]George Milton Laug, "A Study of Expressed Attitudes of Prospective Teachers Taking Part in Practical Conservation Activities," (unpublished Ph.D. dissertation, Syracuse University, 1960), pp. 220-226.

In addition to being pre-tested at the beginning of the course the student also filled out a questionnaire giving information to his background and training. See appendix A.

V. Definition of Terms

A. Attitude: The definition chosen for this investigation is the detailed one by Remmers and Gage who are considered to be authorities on attitude studies.

> . . . attitudes may be roughly defined as feelings for or against something. This definition serves to provide a framework on which may be hung a more rigorous definition.
>
> The term "feeling" points to the difference between attitudes and detailed, rational, intellectual, cognitive mental operations. Attitudes are linked to the emotions; pleasant and unpleasant associations -- fear, rage, love, and all the variations and complications in these emotions brought about by learning -- play a part in attitudes.
>
> The phrase "for or against" expresses the directionality of attitudes, the fact that they are characterized by approach or withdrawal, likes or dislikes, avoidant or adient tendencies, favorable or unfavorable reactions, loves or hates, as these are responses to specific or generalized stimuli.
>
> The word "something" signifies that attitudes are not merely mental images or verbalized ideas, but rather take on meaning only when they are considered in relation to some object, situation or stimulus.
>
> A further characteristic of attitudes is that they have an effect on behavior which may be so great that the attitude enables the prediction of behavior, or which may be influenced in such a way by other forces, social and attitudinal, that the behavior will not follow the expressed attitude, as when a pupil who expressed opposition to cheating proceeds to cheat on an examination. A fifth characteristic of attitudes, to be treated later in more detail, is that they are learned.

> In summary, an attitude may be defined as an emotionalized tendency, organized through experience, to react positively or negatively toward a psychological object.

Remmers and Gage continue their discussion by considering attitudes and certain allied concepts.

> Certain concepts allied to attitudes, some of them essentially synonyms or near-synonyms, may be considered here, since they are frequently used in popular discussion and technical literature. Such concepts are interests, motives, values, appreciation, tastes, mores, morality, morale, ideals, social distance, and character.

They also believe that attitudes have dimensions, and following is a brief definition of each type:

> Favorableness: It is the degree to which one is for or against a given attitude object.
>
> Intensity: Intensity is the strength of the feeling.
>
> Salience: It is the readiness with which the attitude can be aroused, its "closeness to the surface" in a person's mind.
>
> Generality: This is the number and variety of attitude objects toward which a person has a single, internally consistent, overall attitude.
>
> Public vs. Private: Public attitudes are those that people will talk about freely in almost any social situation; the more a person thinks his attitudes are likely to be disapproved or punished, the more private he is likely to keep them.
>
> Common vs. Individual: Common attitudes are when many people have attitudes of more or less favorableness, intensity, and the like toward a given attitude object; individuals may, however, have attitudes toward things that no one else is aware of or cares about.[1]

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[1] H. H. Remmers and N. L. Gage, op. cit., pp. 361-362, 365-368.

Thurstone, a pioneer in the study of attitudes and the constructor of the attitude-type testing that bears his name, gave us another definition of the term:

> An attitude is the degree of positive or negative affect associated with some psychological object. By a psychological object, Thurstone means any symbol, phrase, slogan, person, institution, ideal or idea toward which people can differ with respect to positive or negative affect.[1]

"Affect" has the same meaning as "feeling" in the literature of psychology.

B. Opinion: an expressed attitude.[2]

C. Scale: a term used interchangeably with the word "test".

D. Conservation: the use of natural resources so as to yield, in so far as is possible, maximum benefits on a sustained and permanent basis for the good of the present generation and those to follow.

E. Natural Resources: any natural feature of environment if it has value or usefulness to man.[3]

F. Renewable Resources: living resources plus soil and water which are inseparable from living things.

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[1]Allen E. Edwards, Techniques of Attitude Scale Construction (New York: Appleton-Century-Crofts, 1957), p. 2.

[2]H. H. Remmers, Introduction to Opinion and Attitude Measurement (New York: Harper & Brothers, 1954), p. 7.

[3]Richard M. Highsmith, Jr., J. Granville Jensen and Robert D. Rudd, Conservation in the United States (Chicago: Rand McNally & Co., 1962), p. 1.

G. Non-renewable Resources: non-living materials which in themselves seem to exist in sizeable quantities free and unassociated with living forms, and have no power of reproducing their own kind.

CHAPTER II

STUDIES RELATED TO THE PROBLEM

I. An Analysis of Apparent Emphasis Given to Conservation in Some College Biology Texts

In reviewing new biology textbooks received yearly from various publishers, it is apparent that some authors choose to treat the topic of conservation and others do not. To determine how many are actually including this subject, the contents of twenty college biology textbooks were examined. All twenty were published between the years of 1956-64. The office libraries of four Jackson Junior College biology instructors and the Spring Arbor College biology department library were the sources from which this review was made.

Based upon the findings of this twenty-book sampling, seven authors (35%) devoted one full chapter to conservation. The length of these chapters varied from ten to thirty-three pages with the average being eighteen pages. Thirteen authors (65%) did not give a chapter to conservation; however, most of these did make brief mention of conservation of natural resources in a chapter on ecology. All twenty authors included a full chapter on ecology.

The following table deals with findings of this investigation:

TABLE 1

AN ANALYSIS OF TWENTY COLLEGE BIOLOGY TEXTBOOKS TO DETERMINE THE AMOUNT OF TREATMENT GIVEN TO CONSERVATION INSTRUCTION

Title	Edition	Author	Chapters	Pages
General Biology	1956	Allexander	1	19
General Biology	1956	Wells & H. Wells	1	22
Biology and Its Relation to Mankind	1957	Winchester	0	
The Biotic World and Man	1958	Milne and Milne	1	33
General Biology	1960	Mavor	0	
Principles of Modern Biology	1960	Marsland	0	
Biology	1960	Elliott and Ray	0	
Biology	1960	Brown	1	10
Biology, Its Principles and Implications	1961	Hardin	0	
Elements of Biology	1961	Weisz	0	
General Biology	1961	Core et al	0	
General Biology	1961	Taylor and Weber	0	
General Biology	1961	Johnson et al	0	
Biology, An Introduction to the Science of Life	1962	Goodnight et al	1	12
Principles of Biology	1962	Buffaloe	0	
General Biology	1962	Beaver	1	10
Biology	1962	Villee	0	
General Biology	1963	Kenoyer et al	1	17
The Science of Life	1964	Dillon	0	
Principles of Biology	1964	Whaley et al	0	

II. Studies of Conservation Education in the Colleges of the United States

Very little investigation pertaining to the teaching of conservation in the colleges and universities of the United States has taken place up to this time.

Perhaps the most intensive study was one carried on by Lively and Preiss under the sponsorship of the Conservation Foundation. The data for their report was collected during the calendar year of 1954 and 1955. Questionnaires were sent to the colleges with an enrollment of 7000 or less; for larger institutions official catalogues and other publications were examined instead of using the questionnaire method. The coverage was quite complete as data was gathered from universities, liberal arts colleges, teachers' colleges, junior colleges and technical schools regardless of the size of enrollment.[1]

Some of the important facts which the writer feels pertinent to this study are stated in the summary of the investigation by Lively and Preiss.

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[1]Charles E. Lively and Jack J. Preiss, Conservation Education in American Colleges (New York: The Ronald Press, 1957), p. 55.

Results of a Questionnaire to Administrators
(1024 answering)

1. The percentage teaching some conservation was 55.3. The figure varied from 89.2 per cent among the 130 teachers' colleges to 30 per cent among the ninety-nine special schools. (Teachers' colleges were far above the average.)

2. The work in conservation was offered most frequently in the area of natural science, followed by physical science, geography, social science, agricultural science, education and business, in that order.

3. Six per cent offered a major in the subject and only 1 per cent gave a special degree.

4. Three out of ten offered some extension work, special conservation conferences or short courses.

Results of a Questionnaire
to Teachers of Conservation
(Findings based on 626 teachers located at 566 colleges and universities that were found to be teaching some conservation.)

1. Sixty-nine per cent expressed strong interest in the subject, 28 per cent moderate interest and 2 per cent claimed slight interest.

2. As to a definition of conservation, the replies were grouped into five categories, which included 89 per cent of the answers. The most common definitions were "wise use," 43 per cent; "avoidance of waste and replenishment," 18 per cent; "economic efficiency," 11 per cent; "preservation and frugality of use," 9 per cent; "planned use with controls," 8 per cent.

3. Twenty per cent thought we would reach the limits of the expansion of our national economy within fifty years or less.

4. Ignorance of the rate at which our resources are used was thought to be the chief factor for conservation's lack of popularity. Four other factors mentioned were "carry over of destructive attitudes of the past;" "feeling of irresponsibility for the state of resources;" "pressure from industry to consume and discard;" "the belief that science will save us."

5. On how to make conservation effective, seven out of ten teachers replied that conservation thinking must be made a part of the individual's beliefs.

6. Eighty-eight per cent believed that social sciences have a contribution to make in the field of conservation.

7. Three-fifths of the teachers believed that all college students should study the subject.

8. Two per cent regarded it as non-essential.

9. The teachers favored integrating the subject into related courses as the best method of presenting conservation, although they approved offering it in a special course also.

10. Their major emphasis has been upon concepts and principles.

11. The most common teaching technique was the lecture and class discussion method with field trips and laboratory work next, in that order. Audio-visual aids were next, followed by student projects and reports. Outside speakers were least used.

12. Of the 961 courses reported as containing some conservation content, 224 were classified as concentrated courses.

13. The names chosen for the special course were, conservation of natural resources, 42 percent; special resources, 27 per cent; conservation, 20 per cent; conservation education, 6 per cent; conservation workshop, 5 per cent.

14. Few regarded their library as adequate for the teaching of conservation.[1]

III. Attitude Studies in Conservation

Tests of knowledge of conservation principles have been constructed and in use for some time. Giles' study of con-

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[1] Ibid, pp. 230-253.

servation knowledge of the school children of Virginia is a note-worthy work.[1] His testing involved school children from the sixth through the twelfth grades.

The Conservation Foundation developed, in 1961, an excellent test entitled "Reasoning in Conservation" which may be administered at either the high school or college level. This test endeavored to probe the students' understanding of the implications of the problems in conservation.[2]

The study of attitudes is a comparatively young subject. Early studies in attitudes were carried on in the 1920's by Thurstone and his associates.[3] These were followed by the work of Likert during the 1930's.[4] He built upon the foundation laid by Thurstone and produced the Likert scale which was simpler to construct.

During the past two decades Remmers at Purdue University has made further contributions to the field of attitude studies and is considered to be one of the present day au-

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[1]Robert H. Giles, Jr., Conservation Knowledge of Virginia School Pupils, Virginia Polytechnic Institute and the United States Department of Agriculture cooperating, Bulletin No. 257 (Blacksburg, Va.,: Extension Service, 1958), pp. 7-17.

[2]The Conservation Foundation, in co-operation with Educational Testing Service of Princeton, New Jersey, Test of Reasoning in Conservation (New York: The Conservation Foundation, 1961).

[3]H. H Remmers, op. cit., p. 8.

[4]Rensis Likert, "A Technique for the Measurement of Attitudes," Archives of Psychology, No. 140 (June, 1932), pp. 5-52.

thorities on the subject. His work has been one of making practical application of Thurstone's and Likert's findings.

A review of the related studies revealed that attempts of attitude testing of conservation concepts were first made by Wievel in 1947[1] and Laug in 1960[2].

Wievel's investigation was an earlier attempt to measure both attitudes toward and knowledge of conservation, but his research was conducted on the high school level. The study took place in the state of Iowa during the fall of 1946 and the high schools involved in his study sample were chosen at random. Both freshmen and seniors were tested. These two groups were used in order to determine whether seniors who had received several years of secondary school instruction differed from freshmen who had just entered high school.

Since Wievel was unable at that time to find either an attitude scale or a desirable test of knowledge in conservation, he was forced to construct his own instrument. The test was composed of three parts, (1) a personal data sheet, (2) a twenty-five statement attitude scale of the Likert-type and (3) a seventy-five question multiple choice achievement test. The test was designed so that all students could com-

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[1]Bernard F. Wievel, "Attitude Toward and Knowledge of Conservation Possessed by Students in Iowa High Schools" (unpublished Ph.D. dissertation, Iowa State College, 1947).

[2]George Milton Laug, op. cit.

plete it in one class period. The attitude portion had a reliability coefficient of .71[1] and the achievement portion was .90[2].

Some of the principle conclusions that are of interest to this study were

Grade level. Significant differences in attitude and general and specific achievement existed among the grade level groups, with seniors making higher scores on all parts of the test than freshmen.

Sex. Boys made higher scores than girls on all parts of the test and these differences in scores were significant, except in the case of achievement in mineral conservation.

School marks. Students whose school marks were above average made higher scores on the attitude scale and general achievement test than students whose grades were average or below average.

Place of residence: farm, nonfarm. Place of residence, when classified as farm and nonfarm, was associated with significant differences in general achievement and achievement in soil conservation. Farm students made higher scores on these parts of the test.

Students living on farms did not differ significantly in their attitudes, or in achievement in wildlife, forest, mineral or water conservation from nonfarm students.

Natural science courses. Students who had taken a greater number of courses in the natural sciences had more favorable attitudes toward conservation and made better scores on the general achievement test.

Agriculture courses. Students who had taken some courses in agriculture made higher scores on all parts of the test than students who had not taken these courses.[3]

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[1] Ibid., p. 13

[2] Ibid., p. 24

[3] Ibid., p. 173-176

Social science courses. There was a tendency for students who had taken a greater number of courses in the social sciences to have slightly more favorable attitudes toward conservation and to make slightly lower scores on the general achievement test.

Conservation activities. There was a significant tendency for students who had engaged in a greater number of conservation activities to have made better scores on both the attitude scale and the general achievement test.

Conservation magazines. Students who had read conservation magazines to a greater extent made slightly higher scores on the attitude scale and the general achievement test than students who read these magazines to a lesser extent.

Conservation books and bulletins. Students who had regularly read books and bulletins on conservation topics had more favorable attitudes toward conservation and made higher scores on the general achievement test.[1]

Laug's work was carried on at the State University College at Buffalo, New York. This is one of New York's State Teachers' Colleges and has an enrollment of approximately 4000 students. The college biology class was used in his investigation and was composed of mostly freshmen and a few sophomores. The class was broken down into sections of twenty-five students each and several instructors were involved in addition to Dr. Laug. The course covered two semesters and the investigation took place during the spring semester of 1958.[2]

The teaching unit developed by Laug was a general one in which two weeks of time was allotted to classroom study. Five films on conservation topics were available for those

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[1] Ibid., pp. 176-178.

[2] Personal interview, December 6, 1963.

instructors who chose to supplement the lectures with visual aids.

His major emphasis, however, was placed upon a field experience which he thought would be very important in helping the student formulate favorable attitudes toward conservation principles. The planting of trees and shrubs for food and wildlife cover was the project in which most participated. In addition to the work activities some observations pertaining to conservation practices were made and discussed in the field.

The student could choose between a one- or two-day field trip. Eighty-seven per cent elected the one-day trip, 9 per cent the overnight trip and 4 per cent missed the field experience entirely. Since the trip to the farm took two hours, the time spent in the field was from 10:00 A.M. to 3:30 P.M. The area used was a 435 acre farm owned by the school and purchased with the idea that it could be used as an outdoor laboratory for various classes from the college.

In the instruction of the control group, the two-week classroom conservation unit was not employed nor did it take any part in the field experience.

The first concern of this investigation was to determine if a significant difference existed between the mean of the pre-test and the mean of the post-test for the experimental group. This involved the use of the "t" test for correlated means and there was an advance of 11.51 points for this group. In the case of the control group, the mean

decreased 3.16 points.[1]

Since Laug's experiment made use of three instructors in addition to himself in the teaching of the experimental groups, this presented an opportunity to study the effect of individuals upon the remolding of attitudes. Three of the instructors witnessed a difference between the means of the pre- and post-test of +13.80, +14.83 and +13.27. The fourth had a change of +6.77.[2] Laug believed these differences could be due to varied backgrounds and interests.

A detailed report of his complete findings is not made here but will be mentioned periodically in this paper.

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[1]George M. Laug, "Do It Yourself Conservation and Its Effect Upon Attitudes of Prospective Teachers," The American Biology Teacher, Vol. XXIV (January, 1962), pp. 50-55.

[2]Ibid, p. 54.

CHAPTER III

METHODS OF INVESTIGATION

I. Development of the Teaching Unit in Resource Conservation

Since it is apparent that a large proportion of the students enrolled in the colleges and universities of the United States are never exposed to even one course in conservation during the period of their college career, the writer believes that this situation should be changed and contends that the best starting point to such an introduction may be in the class in biology. It is true that time would not allow for an intensive study, but the student could be acquainted with the basic material and the present day problems and issues.

There are three reasons why this may be the opportune time for this type of teaching:

First, many more young people are entering our colleges and universities each year and educators anticipate no decline in the present trend.

Second, many drop out of college after one or two years and seek employment. These would all become exposed to the information presented by such a unit as most biology courses are required and taught during the freshman year. This much exposure to the subject would certainly be beneficial to the student even though he may never finish college.

Third, for those going on to complete the four-year program, the introduction on the first year level might spark an interest and funnel more into the upper division special courses in conservation.

It is not intended that this brief introduction is to replace the intensive course for teachers and occupational specialists.

With these factors in mind the writer reorganized the biology course at Spring Arbor College for the school year 1963-64. This change was not one suddenly conceived, but had been given much forethought. During the past three years much investigation and reading was done and materials gathered to incorporate into the new program.

Catalog Description of New Course in Biological Science

> An introduction to the nature of life, a study of plants and animals, and their economic and aesthetic value to man. After this basic introduction to the living world the study of the human population problem is considered in relationship to our natural resources.[1]

This semester of study is divided into three parts: the nature of biological science, the nature of life and the perpetuation of life and resources.

Before considering the third unit which dealt with resource conservation, the student had made a basic study of life and living organisms in units one and two. During this time he also was increasing his vocabulary and becoming

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[1]Catalog of Spring Arbor College, 1963-64, p. 15.

better prepared to understand the literature used in the final section. Such words as producer, consumer and decomposer had definitely more of a meaning than word definition could elicit.

A detailed instructional outline appears in appendix D but a brief outline of material covered in the three parts follows:

Part I: The Nature of Biological Science

- A. Introduction to Biological Science and Course Objectives
- B. Introduction to the Literature and Men in Biological Science
- C. Procedure in Science
- D. Limitations of Science

Part II: The Nature of Life

- A. Characteristics of Living Things
- B. The Cell
- C. Growth (Cell Division)
- D. Sexual and Asexual Reproduction
- E. Genetics
- F. How Living Things are Classified
- G. The Animal Kingdom
- H. Evolution
- I. The Plant Kingdom

As previously indicated, part three is the portion of the course with which this investigation is concerned.

Part III: Perpetuation of Life and Resources

- A. The Population Resource Problem
- B. Nature of Resources
- C. Introduction to Ecology
- D. Biotic Regions of North America
- E. Soils and Food
- F. Water
- G. Forests
- H. Wildlife
- I. Conservation of Environment
- J. The Future Outlook

In working out a time budget, five weeks were allotted. Instead of the use of the conventional lecture system only, a combination of six additional teaching techniques were employed. These were visual aids, handout material, publications to keep, independent study, use of a visiting speaker and a one-day field trip. Since many of the students enter the course with little knowledge of the subject and even less interest, it was believed such a combination might be more stimulating than the straight lecture approach.

A. The Lecture.

A series of ten lectures were prepared for part three.[1] To arouse the student to the realization of the importance of conservation, the introductory lecture and reading assignment were concerned with the population crisis in the world today. Few in America have given this subject much thought but when it is finally grasped, the vital necessity of good resource management takes on new significance.

An ecological approach was thought to be the most desirable. Cook, in his writing of a chapter entitled "Design for a Planet," made this statement:

> The science of ecology has been solely the concern of intellectuals too long. If modern, urban-industrial man does not learn what ecology is and

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[1]See appendix E.

> place himself in balance with his environment and his fellow living creatures, ecological forces may destroy him.[1]

Odum in his text Fundamentals of Ecology states, "Conservation in the broadest sense is probably the most important application of ecology."[2]

The textbook used was Environmental Conservation.[3] A lecture on basic ecology and the biotic regions of North America followed the population study.

Because of time limitations, only renewable resources were stressed. Soil, water, forest and wildlife were emphasized with more attention given to soil. Since soil is the link between the rock core of the earth and the living things on its surface,[4] the writer believed that the student should fully realize the value of this basic resource. In addition to the lectures on soils, one double laboratory period was spent on a study of monoliths of the two zonal soils of Michigan and a prairie soil of Northwestern Iowa.

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[1] Mudd, op. cit., p. 422.

[2] Eugene P. Odum, Fundamentals of Ecology (2d.ed. Philadelphia: W. B. Saunders Co., 1959), p. 421.

[3] Dasmann, op. cit.

[4] Roy W. Simonson, "What Soils Are," Yearbook of Agriculture (Washington: U. S. Government Printing Office, 1957), p. 17.

Classroom study of a gray-brown podzolic soil profile. (Hillsdale sandy loam)

Classroom study of a podzol soil profile. (Kalkaska sand)

Monoliths Used in Laboratory

Soil Type	Great Soil Group
Kalkaska sand	Podzol
Hillsdale sandy loam	Gray-Brown Podzolic
Galva silt loam	Brunizem

In addition to the above three mineral soils, the students were introduced to the organic soils, peat and muck.

The study of renewable resources was followed by the subject, "Conservation of Environment." This is no doubt one of the most strategic topics considered, as the setting aside of recreational, natural and wilderness areas is an assignment which must be carried out by the present generation.

The final lecture dealt with the subject, "Where Do We Go From Here?" The problems and some possible solutions were outlined. This also presented the final opportunity to point out that the task ahead is too great for professional men alone. They need and must have the cooperation of the entire citizenary.

B. Visual Aids.

Three and one-quarter hours of the class time were taken by the showing of five motion pictures on some of the topics considered in this unit. The writer believes this was time well spent as the viewing of films forms lasting impressions.

Description of Films Used

Film 1

Subject: Population Explosion
Time: 45 minutes
Producer: Carousel Films, Inc.
Source: Michigan State University Audio-Visual Center

This film considers the consequences of current rate of growth of the world's population in relation to potential food and space. It centers on India and presents its current problems.

Film 2

Subject: Tropical Rain Forest
Time: 16 minutes
Producer: Encyclopaedia Britannica Films, Inc.
Source: Michigan State University Audio-Visual Center

Ecological interrelationships of the complex environment of the tropical rain forest are illustrated in this film. It stresses the importance of temperature and rainfall in the tropics and illustrates ecological concepts such as niche, climax and plant succession.

Film 3

Subject: Water Famine
Time: 54 minutes
Producer: Carousel Films, Inc.
Source: Michigan State University Audio-Visual Center

This film takes up the role of water in the birth and decay of civilization; the problems of man as he searches for new sources and the critical water shortage and problems of pollution created by the population explosion. It also shows the modern miracle of desalinization of sea water by two processes.

Film 4

Subject: The River Grand
Time: 29 minutes
Producer: Michigan Department of Conservation
Source: Michigan Department of Conservation

The beginning of this film is with the headwaters in Jackson and Hillsdale counties and follows the Grand River until it empties into Lake Michigan at Grand Haven. It shows a close view of the pollution of a once grand river by sewage and industrial wastes. It probably has added significance and impact because of its close proximity and local implications.

Film 5

Subject: Wildlife and the Human Touch
Time: 19 minutes
Producer: Forest Service
Source: Forest Service, U. S. Department of Agriculture

This film portrays the flora and fauna of a national forest and stresses habitat management and the benefits derived therefrom. The multiple use concept is the central theme of this production.

In addition to the above colored movies, fifty-eight kodachrome transparencies were used to illustrate the lecture, "The Nature of Resources." These were drawn from the slide library of the biology department at Spring Arbor College.

C. Mimeographed Handout Material.

Each student received a copy of the following twenty pieces of material especially prepared to supplement the lectures. Copies appear in appendix F.

Introductory Material

1. Introduction and course outline
2. Reading assignments for conservation unit
3. Publications in college library pertaining to biology and conservation
4. Selected books in the Spring Arbor College Library on renewable resources

Population

5. World population growth, 5000 BC - 2000 AD
6. Increase in U. S. population and in use of various raw materials and resources
7. Curve of population growth

Ecology

8. A biotic pyramid
9. Ecological books available in the college library

Soils

10. Great soil groups of North America
11. Profile of Miami Loam (a Gray-Brown Podsolic soil)
12. Profile of Kalkaska sand (a Podzol soil)
13. Horizon formation
14. "Ideal" composition of soil by volume of silt loam textured A1 horizon
15. Distribution of cultivated land among the fifteen countries having more than 75 per cent of the world's total cultivated land
16. A glossary of terms used in the soils study

Forests

17. Forests of Michigan (state, national and school and community)

Wildlife

18. Wildlife extinct or threatened
19. Present wildlife resources

Field Trip

20. An introduction to the W. K. Kellogg Bird Sanctuary

D. Printed Matter

Five copies of bulletins pertaining to various aspects of conservation were distributed to each member of the class. This material not only had immediate use but was valuable for possible future reference as each student was permitted to keep all five publications.

Know Your Soil. U. S. Department of Agriculture Bulletin, No. 267, 1963.

Our Kalamazoo River Valley. Kalamazoo Valley Natural Resources Council, n.d.

Our Native Land. National Association of Manufacturers, 1962.

Visitors' Guide to the W. K. Kellogg Experimental Forest, Michigan State University, n.d.

Wildlife, An Extra Gift From the Land, Extension Folder F-280, Michigan State University, 1963.

E. Independent Study

At the beginning of this unit of study each member of the class received a copy of the assigned readings from the textbook and material on reserve in the library.[1]

To insure availability of the reserve reading material eight copies of each of the following publications were secured and placed at the disposal of the students.

Robert C. Cook. Population and Food Supply. United Nations Office of Public Information, 1962.

Charles E. Kellogg. Soil. Reprint from Scientific American, July, 1950.

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[1]See appendix C.

E. P. Whiteside, I. F. Schneider and R. L. Cook. Soils of Michigan. Lansing Agriculture Experiment Station, Michigan State University.

Concepts of Conservation. The Conservation Foundation, New York, 1963.

Our Forest Bounty. American Forest Products Industries, Inc., Washington, 1961.

The Struggle for Clean Water. U. S. Dept. of Health, Education and Welfare, Washington, 1962.

F. Visiting Speaker.

The study of soils was terminated with a lecture given by a specialist in this field, Dr. Henry Foth, of the Soils Department of Michigan State University. His topic was, "Soil Conservation as Intelligent Use."[1] The stress was upon the concept that soil productivity can be maintained and even improved with proper management. It was a positive approach to the subject of soil conservation.

G. The Field Trip.

The motive in planning a field trip was to give a practical application of the material covered in the classroom.

In November, 1963 the writer met with Mr. Walter Lemmien of the W. K. Kellogg Experimental Forest and Mr. R. C. Van Duesen of the W. K. Kellogg Bird Sanctuary to discuss the objectives for the one-day field trip. Each man was then sent a copy of the course outline so he could plan

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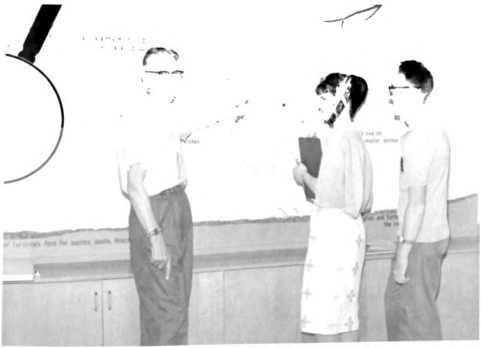
[1]See appendix E

Experimental class preparing to leave the campus for the all day field trip.

Lecture by director, R. C. Van Deusen on history and objectives of the W. K. Kellogg Bird Sanctuary.

Observing waterfowl at the sanctuary waterfront



Dr. Walter Morofsky talking to
class on aquatic ecology

the day accordingly.

The field trip took place on Tuesday, May 19, 1964, during the last week of regular classes. All students were required to participate and take notes to be turned in at the next lecture session.

On Monday before the field trip the last twenty minutes of class time were spent briefing the class on plans and objectives of the trip. At this time the two-page introduction to the W. K. Kellogg Bird Sanctuary prepared for our group by Mr. Van Deusen was distributed.[1]

The Field Trip Schedule

8:00 Depart for sanctuary
9:15 Arrive at sanctuary
9:30 Illustrated lecture by Mr. Van Deusen entitled, "The Sanctuary Story."
10:15 Tour of the area visiting live bird and mammal displays and the lake front.
11:15 Met in research building with Dr. Walter Morofsky for a lecture on acquatic life of the Augusta Creek.
12:00 Lunch at the forest area picnic grounds
1:00 Tour of forest area with Mr. Lemmien. The following observations were made at the experimental forest area:

1. Multiple use of the area
2. Deer browse problem
3. Planting and thinning techniques
4. Difference in the forest floor of deciduous and conifer plantings
5. Advantages of mixed stands for use by wildlife
6. Natural reproduction of trees
7. Self-pruning
8. Tree harvest methods
9. Sustained yield practice
10. Use of herbicides
11. Pulp wood harvest
12. Food patch plantings

3:00 Return to the campus

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[1]See appendix F

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11. Pulp wood harvest
12. Food patch plantings

3:00 Return to the campus

[1]See appendix F

Mr. Lemmien and Mr. Van Deusen are to be commended for having the day so well organized that conducting a trip with sixty-seven students did not prove to be a problem. Only one student missed the trip.

II. Selection of Study Groups

The plans first formulated were to use Northwestern as the control and Spring Arbor College as the experimental group. To determine whether this was the best procedure to follow, the writer conferred with Dr. Morris Axelrod, a representative of the Institute for Social Research at Ann Arbor, Michigan for advice on this question. The plans above stated were presented to him and he advised both the control group and experimental group be on our campus. Thus a change was made to use the first semester class as a control and the second semester class as the experimental group. Since a second control might offer some added information it was decided to also use the first semester biological science class of Northwestern College.

A requirement of all non-science majors at Spring Arbor College is one year of natural science taken during the freshman year which consists of one semester of biological science and one of physical science. At the fall registration one-half of the freshmen register for one of these two subjects and at the termination of the first semester they switch courses, thus fulfilling the requirement of one year of natural science.

The sorting of students into the above two courses was a random one. Those working on registration at the beginning of the fall semester were instructed to do so in order that the two classes would be numerically in balance between biology and physical science.

At the beginning of the second semester the total grade point averages of the out-going and in-coming classes were compared to determine the scholastic achievements of each group. The results indicated the two groups to be about equal as the grade point average of the first semester class was 2.45 and the second semester, 2.50.

Near the end of the second semester the experimental group was asked to state their occupational plans on a blank sheet of paper without revealing their names.

TABLE 2

Occupational Choice as Indicated by Experimental Class

Occupational Choice	Number of Students
Teacher	44
Business	4
Housewife	4
Minister	4
Coach	3
Law	1
Floriculture	1
Personnel work	1
Social work	1
Missionary	1
Undecided	1

The results of this question revealed that 72 per cent plan to enter the teaching or coaching profession.

Northwestern College was chosen as the second control because its situation is so similar to that of Spring Arbor College. Both schools have approximately the same enrollment and are in the process of moving from a Junior College to a four-year liberal arts program with a teacher training emphasis. Northwestern College is also a church related college and is affiliated with the Reformed Church of North America. They also require of their freshmen a course in natural science composed of one semester of biology and one of physical science.[1] The text used was Biology, Its Principles and Implications by Garrett Hardin.[2] This text does not include any work on conservation nor does the instructor, Mr. Virgil Muilenberg, inject any into his teaching of the subject.

III. The Research Instrument

For decades resources were considered inexhaustible, and the wilderness was regarded as an enemy to be subdued. These attitudes lingered into the twentieth century despite the vast destruction of wildlife, forests, land and water.[3] Conservation education seeks to instill within man a new

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[1]Catalog of Northwestern College, 1963-64.

[2]Garrett Hardin, Biology, Its Principles and Implications (San Francisco: W. H. Freeman & Co., 1961).

[3]Ernie Swift, "Straight Talk," National Wildlife, January-February, 1964, p. 21.

attitude toward nature, one far less careless and matter-of-fact than that typically found in former days.

The conservation educationist, in teaching his subject, presents facts and findings and strongly hopes that some of the unfavorable attitudes of the students will be changed. Such changes are essential if he is to succeed at the task of reshaping attitudes toward natural resources.

Questions might arise as to the stability of attitudes. Can they be modified or do they remain constant over a period of time? After many years of investigation, Remmers has concluded that attitudes can be changed and that these changes persist for some time.[1] Peterson and Thurstone demonstrated that the changed attitudes from seeing a single movie persisted for as much as a year and a half.[2]

Regarding the value of attitude measurement to society, Remmers contended that

> The realization is rapidly growing that attitudes, the way individuals and groups feel about the various aspects of their world, are probably more determinative of behavior than mere cognitive understanding of this world. When this is granted, the importance and value of attitude measurement becomes at once obvious.[3]

If it is important that our society possesses a proper set of attitudes it then becomes apparent that we are not just teaching conservation facts, but are also helping to shape or reshape attitudes in a favorable direction. Thus

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[1]Remmers, op. cit., p. 6.

[2]Ibid, p. 6.

[3]Ibid, p. 15.

this study is concerned with this problem: Is conservation instruction in our schools actually producing favorable attitudes?

Remmers and Gage commented on the importance of evaluating our teaching:

> The attitudes of pupils may be evaluated as educational outcomes, as indications of the degree to which pupils have acquired certain attitudes set up as objectives of instruction. Attitudes may be and have been considered as objectives of instruction in all areas of the curriculum, including social studies, mathematics, natural science, art, and language studies.[1]

Several approaches have been utilized by research workers in learning the opinions and attitudes of the public. Four of the many methods of investigation are forthwith discussed.

1. Direct Observation of Behavior

One approach to the problem of studying attitudes is to observe the behavior of people with respect to a psychological object. The chief drawback of observation is the fact that it can be very time consuming. Also, should behavior with respect to the object eventually occur it may fail to reveal the feelings of the individual as behavior is sometimes designed to conceal feelings.[2] Finally, only limited observations could be made unless a great number of persons take part in the investigation.

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[1] Remmers and Gage, op. cit., p. 382

[2] Edwards, op. cit., p. 6.

2. Direct Questioning

Another way to learn how individuals feel about a particular object is simply to ask them a direct question. This method is satisfactory for some purposes but it, too, has its limitations. The chief criticism of this system is the reluctance that most people have of giving a public expression of their feelings, especially if the object pertains to a controversial subject. The answer may be simply "yes" or "no", or an indication of the strength of opinion may be gathered by asking subjects if they agree, are undecided or disagree with the statement.

3. Thurstone's Method of Equal-appearing Intervals

This method, developed during the late "twenties", is an application of a well-known psychophysical technique to the problem of attitude scaling, and represents an attempt to develop a "rational" scale based on psychologically defined units. The statements collected for this type of scale should cover the entire continuum of attitudes toward the object in question, from extremely unfavorable on the one hand to extremely favorable on the other. The collection of opinion statements are then given to a team of judges and they are instructed to sort the statements into eleven groups (if an eleven point scale is desired, though a nine point scale is frequently used). At one end of the series of eleven groups will be statements expressing an extremely unfavorable attitude; at the other end an

extremely favorable one. The sixth group (middle one) should contain statements expressing a neutral attitude. Thus, when all of the statements have been sorted by the judges an attitude continuum with equal intervals has been established from one extreme to the other. The position of the judges should play no part in this sorting process. The subject, in filling out the questionnaire, is asked to check the statements with which he fully agrees. The mean (or median) of the scale values of the items checked is interpreted as indicating his position on a scale of favorable-unfavorable attitudes toward the object.

4. Likert's Method of Summated Ratings

This method is considered by many to be an improvement over Thurstone's scale as it does not require judges. Both types of tests are considered dependable, but it would seem that a perfect scale is yet to be devised. Refinements have come about as persons with a strong interest in this form of psychological testing have built upon the findings of their predecessors.

The Likert-type scale, devised by Rensis Likert in 1932, has several advantages over the Thurstone scale. First, it permits the use of items that are not manifestly related to the attitude being studied. Second, a Likert-type scale is simpler to construct. Third, it is likely

to be more reliable than a Thurstone scale of the same number of items. Fourth, the range of responses permitted on a Likert-type scale item provides, in effect, more precise information about the individual's opinion on the issue referred to be a given item.[1] In other words it has the ability to measure the strength of the opinion.

The Likert-type scale is the one employed in this study. The procedure for its construction is quite simple. The first step is to assemble a large number of items considered relevant to the attitude under investigation and either clearly favorable or clearly unfavorable. The investigator may be able to prepare some of the statements, but he may skillfully draw from editorials, periodicals and books; second, note verbal expressions of the public.

Over the years criteria for the editing of the statements to be used in the construction of attitude scales have been suggested by Wang, Thurstone and Chave, Likert, Bird and Edwards and Kilpatrick.

1. Avoid statements that refer to the past rather than to the present.

2. Avoid statements that are factual or capable of being interpreted as factual.

3. Avoid statements that may be interpreted in more than one way.

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[1]Claire Selltiz et al, Research Methods in Social Relations (rev.ed. New York: Holt, Rinehart and Winston, 1959), pp. 368-369.

4. Avoid statements that are irrelevant to the psychological object under consideration.

5. Avoid statements that are likely to be endorsed by almost everyone or by almost no one.

6. Select statements that are believed to cover the entire range of the affective scale of interest.

7. Keep the language of the statements simple, clear and direct.

8. Statements should be short, rarely exceeding twenty words.

9. Each statement should contain only one complete thought.

10. Statements containing universals such as all, always, none, and never often introduce ambiguity and should be avoided.

11. Words such as only, just merely, and others of a smiliar nature should be used with care and moderation in writing statements.

12. Whenever possible, statements should be in the form of compound or complex sentences.

13. Avoid the use of words that may not be understood by those who are to be given the completed scale.

14. Avoid the use of double negatives.[1]

After the statements have been carefully prepared and edited according to the above guidelines, the items are assembled and administered to a group of subjects representative of those with whom the questionnaire is to be used. The responses are then scored in such a way that the most favorable attitude is given the highest score. The usual method of constructing the scale is to employ five degrees

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[1]Edwards, op. cit., pp. 13-14.

of response, SA meaning strongly agree, A meaning agree, U meaning undecided, D meaning disagree, and SD meaning strongly disagree. With this procedure the basis for the score is four points for full agreement with a favorable attitude, three points for one step removed from full agreement, two points for two steps removed, one point for three steps removed and 0 for complete lack of agreement with a favorable attitude. For an unfavorable attitude statement, the scoring is reversed. The score of each individual is then computed by adding his item score. The final step, before administering the scale to experimental groups, is to analyze the responses to determine which of the items discriminate most clearly between the high scores and the low scores on the total scale. Faulty statements should be eliminated to insure that the questionnaire is "internally consistent."[1]

The usual procedure of one desiring to make attitude measurements is to first determine whether or not a suitable test has been devised for the area of interest. If one can be located and is reliable it is utilized. If one cannot be found, the investigator must then proceed to gather items and construct his own scale.

Dr. Laug, for his investigation of 1958 with the spring semester biology classes of University College of Buffalo,

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[1]Selltiz, op. cit., pp. 184-185

was unable to uncover a suitable scale for the college age student that would be applicable to his locality. The nearest he could find was one devised by Wieval constructed to test conservation attitudes of the high school student in the state of Iowa.[1] Thus, Laug decided that an instrument of the type he required was not yet in existence so he proceeded to develop one of his own.

Three hundred attitude statements concerning conservation concepts were assembled on 3x5 cards. These were statements he had heard expressed verbally by teachers, students and persons from all walks of life, and from literature. The next step was to study these carefully and delete statements that were ambiguous, of a highly emotional nature, concerned with a localized situation or mere variations of a single attitude. In this deleting process, he attempted to conform to the criteria for editing statements as characterized by Wang, Thurstone and Chave, Likert, Bird and Edwards, and Kilpatrick.[2] After applying the above mentioned methods, the original three hundred statements were reduced to eighty-four. These remaining statements were examined by eight men from the field of conservation education. They were requested to indicate which items they felt were not applicable and to reword statements they

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[1]Laug, op. cit., p. 38.

[2]See pp. 46-47 of this thesis.

felt should be salvaged. It was necessary that the terminology be such as could be understood by college freshmen as all participants should be able to fully comprehend the statements. Those who cooperated in this analysis are listed on page forty-three of Laug's thesis.[1] Only items that met the approval of six of the eight men were retained.

The scale was then administered to a test group of seventy students to further analyze and determine whether any more items should be deleted. By the above mentioned methods of testing, the original three hundred statements were finally reduced to sixty-six which Dr. Laug used in his investigation.

The writer had originally planned to construct his own scale and was in the process of assembling materials from men in the field of conservation education who had consented to contribute statements. This plan was abandoned after the interview with Dr. Morris Axelrod of the Institute of Social Research at Ann Arbor, Michigan on June 14, 1963. The primary purpose of the trip to the Institute was to talk with an authority on attitude testing and receive further advice on scale construction. Dr. Axelrod's recommendation was to utilize one that had already been constructed, if possible. Dr. Laug's scale of sixty-six items was then discussed and he strongly urged using it as this would also offer an opportunity to compare findings.

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[1] Laug, op. cit., p. 43.

Dr. Laug was then approached to ascertain the possibility of using the scale he had developed. Premission was granted with the privilege of making any desired changes in the format.[1] Three minor revisions were made:

1. In the testing portion of the scale, the five responses SA, A, U, D, SD were placed before each statement instead of after. This was done to facilitate I. B. M. tabulations.

2. On page one of the personal data sheet the student was asked to check where he had spent the greater part of his life, "city," suburbs," or "country." "Village" was added as a fourth possible answer, a village being described as having a population of 2500 or less.

3. Instead of a mimeographed stapled test, it was printed in a four sheet folder form.[2]

There were several reasons, in addition to the recommendation by Dr. Axelrod, why Dr. Laug's scale was chosen for the investigation on the Spring Arbor College campus. First, it had a high coefficient of reliability, established to be .94 by using the Pearson product moment "r" and the Spearman-Brown prophecy formula.[3] According to Guilford

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[1]See appendix B.

[2]See appendix A.

[3]Laug, op. cit., p. 47.

the reliability coefficient should be in the upper brackets of "r" values, usually.80 to .98.[1] Also, since standardized tests published for use in schools have a reliability coefficient of .80 or higher in the population for which they are designed, Laug's reliability of .94 indicates that his scale measured accurately that for which it was constructed to test.[2]

Second, much time was spent in its construction. Third, he had a large number of original statements to work with. Fourth, several experts in the field of conservation acted in an advisory capacity in selecting statements for the scale. Fifth, a test designed for western New York state should be acceptable in Michigan as geographical conditions are quite similar. Most of the students tested on the Spring Arbor College Campus were from Michigan, Ohio, Indiana, Illinois, Pennsylvania, and New York. Sixth, the scale was constructed on the level of college freshmen and the terminology was clear and direct.

IV. Administration of the Scale

As previously stated, this experiment involved both the first and second semester biology classes at Spring Arbor

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[1] J. P. Guilford, Fundamental Statistics in Psychology and Education (2d.ed. New York: McGraw-Hill Book Co., 1950), pp. 166-167.

[2] Remmers and Gage, op. cit., pp. 140-141.

College and the first semester biology class at Northwestern College in Orange City, Iowa. Both schools offer a one-semester course in this subject. The writer was the instructor of both classes conducted on the Spring Arbor campus and Mr. Virgil Muilenburg was the one involved at Northwestern College. The first semester classes, one from each of these two schools, furnished the two control groups. The second semester class at Spring Arbor College was then designated as the experimental group. It was into this course that the five-week unit on conservation of natural resources was incorporated. This unit was not introduced to the control groups, rather, the usual basic biology course was taught. Northwestern followed Hardin's text closely and this book presents no information pertaining to conservation.[1] Mr. Muilenburg also advised that he did not include any instruction of this type in his biology teaching. All groups were tested at both the beginning and end of the course to determine whether there had been any attitude changes, and if so, how great the changes and in which direction.

Dr. Laug's scale was used in this experiment and it took from fifteen to twenty minutes to complete.[2] The pretesting took place at the end of the first week of school and the post-testing after the educational experience of the

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[1]Hardin, op. cit.

[2]See appendix A.

semester during the last week of school. All students were involved in the testing experiences in the first semester classes. The second semester class included four foreign students who had neither the grasp of the English language nor the educational background equivalent to that of the other members of the class. Therefore, it was thought best to permit them to take the test but not to include their scores in the findings of this research.

In the administration of the scale, each student was assigned a number which was passed out at random. This method was used as it was believed a student might be more apt to reveal his true feelings if he remained anonymous. If the name was to be written on the test there could be the possibility of checking the statements with the idea of pleasing the instructor rather than indicating true feelings.

Blank slips of paper were handed out to the students with instructions to record their name and number. These were collected, placed in an envelope and sealed before the class. The students were told that these slips would be destroyed after a check was made to make sure the same number appeared on both the pre- and post-tests, as this investigation did not involve the correlation of names with scores.

Before indicating their reactions to the sixty-six statements on the scale, the students were requested to complete the personal data sheet. The following written

instructions preceded the statements on the test:

> We are concerned with your opinions regarding conservation. If this questionnaire is to be of any value, your responses must be honest. This is not a test and you will not be graded. For each of the following statements, encircle the letter or letters which most closely represent <u>your</u> idea concerning that statement. Do not respond as you think you <u>should</u> but instead according to how you feel personally.[1]

The post-testing at the end of the course was administered in the same manner except the students were not required to complete the personal data information a second time. The envelope containing the name and number of each student was opened and the slips were distributed by an assistant. It was very important that the same number appeared on both tests. The time lapse between the two testings was a full semester, theoretically, at least, minimizing the memory factor.

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[1]See appendix A.

CHAPTER IV

ANALYSIS OF DATA

As previously stated the objective of this study was to determine if it was possible to create or modify existing attitudes toward conservation concepts through the teaching of conservation principles. A five-week unit on conservation of the four renewable resources, soil, water, forest and wildlife was prepared and implemented, making use of seven commonly used teaching techniques. These included lectures, visual aids, mimeographed handout materials, publications to keep, independent study, a visiting speaker, and a one-day field trip. Important principles were stressed.

This investigation involved a study of the difference between means with the students being tested at the beginning of the semester and at the termination of the semester with the same attitude scale. Uncorrelated conditions were also studied as the findings of one group were compared with that of another.

In a study of this type there is always a question as to the point where one can be reasonably sure that a difference between two means is large enough to be considered real and dependable. The null hypothesis, a useful tool in testing the significance of differences, was employed in this study. This hypothesis asserts that there is no true difference between two populations means, and that the difference

found between sample means is, therefore, accidental and unimportant. It constitutes a challenge; and the function of an experiment is to give the facts a chance to refute, or fail to refute, this challenge.[1]

According to Garrett a difference is called significant when the probability is so high that it cannot be attributed to chance (i.e., temporary and accidental) factors and hence represents a true difference between population means. A difference is declared not significant when it appears reasonably certain that the derived difference could have arisen from sampling procedures, hence implying no real or true difference between the means.[2]

To determine whether a difference between two paired means was significant the "t" test was utilized. The formula used was as follows:

$$\text{"t"} = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{S^2_{\bar{X}_1} + S^2_{\bar{X}_2}}}$$

When the calculations of the "t" test were made the writer chose to round off all figures at the third decimal place.

The 1% level of confidence was adopted as the criterion of significance for this study with 5% being considered of

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[1]Henry E. Garrett, Statistics in Psychology and Education, New York, Longmans, Green & Co., 1926, p. 213.

[2]Ibid., p. 212.

questionable significance. All levels above that were considered as not significant. The term 1% level of confidence means there is less than one chance in a hundred that a "t" value as large or larger than that computed could have occurred by chance. With such a "t" obtained from a sample, we could reject the null hypothesis with the confidence of being correct ninety-nine times in one hundred.

Guilford stated the generalized criteria for significance or confidence levels of "t" in a normal distribution as follows:[1]

Level of "t"	Level of Confidence	Rough Conclusions
Below 1.65	Below 10% level	Insignificant
1.65	At the 10% level	Insignificant
1.96	At the 5% level	Significant
2.33	At the 2% level	Significant
2.58	At the 1% level	Very significant

In order to reduce the human factor to a minimum all of the attitude scales were IBM scored, with essential data being tallied and coded.

The primary concern of the writer in this investigation was to determine if any significant difference existed between the mean of the pre-test and the mean of the post-test for the experimental group. The statistical test for significance of this data appears in the following table:

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[1]Guilford, op. cit., p. 209.

TABLE 3

t-TEST FOR CORRELATED MEANS OF ALL EXPERIMENTAL GROUP PRE- AND POST-TESTING

Experimental Group	N	Mean	$\bar{D}$	$\overline{SD}$	t
Pre-Test	63	179.127			
Post-Test	63	188.190	9.063	3.038	2.983**

**Sig. at 1% level of con.

$N_1+N_2-2=d_f$
63+63- 2 = 124 degrees of freedom

Table of "t"
t - (.05) - 1.98
t - (.01) - 2.62

Upon entering the "t" table[1] with 124 degrees of freedom the observed "t" turned out to be significant at the 1% level of confidence. In this case the null hypothesis for means is refuted by demonstrating a difference which cannot be explained by chance. There was an increase in the mean between the pre-test and post-test of the experimental group. The mean of the post-test increased 9.063 points over the mean of the pre-test.

The findings of Dr. Laug were studied to determine how they compared to those of the present study. It was discovered that in the pre-test situation of the experimental group, there was a difference of 0.657 points between the mean of his group and that of the writer's. Dr. Laug's study

[1]Herbert Arkin and Raymond R. Colton, Tables for Statisticians (New York; Barnes and Noble, Inc., 1950), p. 116.

took place on the campus of the State University of New York, College of Buffalo and the mean for his group was 178.47 on the pre-test whereas the mean for the Spring Arbor College group was 179.127. The post-test data revealed that his group was able to raise their scores by 11.51 points which was significant at the 1% level of confidence. (Dr. Laug did not check for confidence at the 5% level). The data also indicated that he was working with large numbers as he had 427 in the experimental group and 287 in the control group.

The two control groups were then subjected to the same statistical analysis as the experimental group. Again the "t" test for testing the significant difference between two means was employed.

The results of the treatment for the Spring Arbor College control group appears in the following table:

TABLE 4

t-TEST FOR CORRELATED MEANS OF ALL SPRING ARBOR CONTROL GROUP, PRE- AND POST-TESTING

Control Group	N	Mean	$\bar{D}$	$\overline{SD}$	t
Pre-Test	68	178.838			
Post-Test	68	182.147	3.309	2.941	1.125

$N_1 + N_2 - 2 = d_f$

$68 + 68 - 2 = 134$ degrees of freedom

Table of "t"

t - (.05) - 1.98
t - (.01) - 2.62

Upon entering the "t" table with 134 degrees of freedom the observed "t" turned out to lack significance at either the 1% or 5% level of confidence, which resulted in the acceptance of the null hypothesis. The difference between the mean of the pre-test and the post-test was 3.309 points.

Laug's control group had a mean of 182.81 on the pre-test and a mean of 179.65 on the post-test, a difference of 3.16 points which was significant.

It was believed that a control group composed of students at Spring Arbor College would be very meaningful, but it was also decided to utilize the control group procedure on another campus. Northwestern College of Orange City, Iowa supplied this second control group. The results of the statistical test for significance of the data secured at Northwestern College is found in the following table:

TABLE 5

t-TEST FOR CORRELATED MEANS OF ALL NORTHWESTERN CONTROL GROUP, PRE- AND POST-TESTING

Control Group	N	Mean	$\bar{D}$	$\overline{SD}$	t
Pre-Test	42	177.190			
Post-Test	42	175.548	1.642	3.612	.455

$N_1 + N_2 - 2 = d_f$

$42 + 42 - 2 = 82$ degrees of freedom

Table of "t"

t - (.05) - 1.99
t - (.01) - 2.64

Upon entering the "t" table with eighty-two degrees of freedom it was discovered that the change was not significant at either the 1% level or 5% level of confidence. It was again necessary to accept the null hypothesis. In this group there was a change of 1.642 points between the means of the pre-test and the post-test but the change represented a decrease.

Next, the Spring Arbor College experimental and control groups were compared on both the pre-test and post-test situations. Since this involved the comparison of different sample groups an uncorrelated condition existed and the "F" test was employed to test for significance between variability for two groups.

TABLE 6

F-TEST FOR HOMOGENEITY OF SPRING ARBOR COLLEGE EXPERIMENTAL AND CONTROL POPULATIONS ON PRE- AND POST-TESTING

Testing Situation	Test	N	Mean	S^2	F
Pre-Test	Exper.	63	179.127	273.629	
Pre-Test	Con.	68	178.838	295.134	.927
Post-Test	Exper.	63	188.190	308.097	
Post-Test	Con.	68	182.147	293.090	1.051

	Table of "F"
$N_1 - 1 = d_f$	
62 and 67 degrees of freedom	F - (.05) - 1.54 F - (.01) - 1.84

Upon entering the "F" table with sixty-two and sixty-seven degrees of freedom, the "F" value for the pre-test experimental and pre-test control was not significant at either the 1% or 5% levels of confidence; thus the null hypothesis was not rejected implying that so far as variability is concerned the two samples could have come from the same population. The "F" for the post-test experimental and the post-test control also fell below the 1% and 5% levels of confidence. Thus, it was concluded that both groups could have come from a common population having the same variance.

The data was then subjected to the "t" test. The table that follows contains the data and resulting "t" values of this study:

TABLE 7

t-TEST FOR UNCORRELATED MEAN DIFFERENCES OF SPRING ARBOR COLLEGE EXPERIMENTAL AND CONTROL GROUPS ON PRE- AND POST-TESTING

Testing Situation	Test	N	Mean	$\bar{D}$	$\overline{SD}$	t
Pre-Test	Exper.	63	179.127			
Pre-Test	Con.	68	178.838	.289	2.947	.098
Post-Test	Exper.	63	188.190			
Post-Test	Con.	68	182.147	6.043	3.033	1.992**

*Sig. at 5% level of con.

$N_1 + N_2 - 2 = d_f$

$63 + 68 - 2 = 129 d_f$

Table of "t"

t - (.05) - 1.98
t - (.01) - 2.62

Upon entering the "t" table with 129 degrees of freedom for the pre-test experimental and the pre-test control, the observed "t" was found to be non-significant at both the 1% and 5% levels of confidence. The difference between the means of these two groups was only .289 points. In the case of the post-test experimental and post-test control the observed "t" was significant at the 5% level but not significant at the 1% level of confidence, the difference between the two means being 6.043 points. Since the 1% level of confidence was adopted as the criterion of significance for this study the null hypothesis is accepted.

On the pre-test comparison Laug's control group had a mean of 182.81 and his experimental group a mean of 178.47, or a difference of 4.34 points. On the post-test comparison the experimental group had a mean of 189.98 and the control a mean of 179.65, a difference of 10.33 points. The difference between the means in both of these cases was significant at the 1% level of confidence.[1]

From this point on the statistical analysis dealt only with the experimental group. In the table which follows, male and female members of the experimental group were compared. The "F" test for the homogeneity of variance was applied.

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[1]Laug, op. cit., p. 58.

TABLE 8

F-TEST FOR HOMOGENEITY OF EXPERIMENTAL MALE AND FEMALE POPULATIONS ON PRE- AND POST-TESTING

Testing Situation	Sex	N	Mean	S^2	F
Pre-Test	Male	35	177.343	344.941	
Pre-Test	Female	28	181.357	184.704	.535
Post-Test	Male	35	186.886	380.824	
Post-Test	Female	28	189.821	222.963	.585

$N_1 - 1 = d_f$	Table of "F"
27 and 34 degrees of freedom	F - (.05) - 1.84 F - (.01) - 2.38

Upon entering the "F" table with twenty-seven and thirty-four degrees of freedom it was found that neither "F" was significant at the two levels. The null hypothesis was not rejected, and so far as variability is concerned the two samples could have come from the same population.

The same data was then treated by means of the "t" technique for uncorrelated means in the combined table that follows:

TABLE 9

t-TEST FOR UNCORRELATED MEAN DIFFERENCES OF EXPERIMENTAL MALE AND FEMALE GROUPS ON PRE- AND POST-TESTING

Testing Situation	Sex	N	Mean	$\bar{D}$	$\overline{SD}$	t
Pre-Test	Male	35	177.343			
Pre-Test	Female	28	181.357	4.014	4.056	.990
Post-Test	Male	35	186.886			
Post-Test	Female	28	189.821	2.935	4.341	.676

$N_1 + N_2 - 2 = d_f$

35+ 28- 2 = 61 degrees of freedom

Table of "t"

t - (.05) - 2.00
t - (.01) - 2.66

Upon entering the "t" table with sixty-one degrees of freedom neither of the "t's" was found to be significant at either the 1% or 5% levels of confidence. On the basis of this analysis the null hypothesis was accepted. It was noted that the women members of the class were 4.014 points higher than the men on the pre-test and were 2.935 points higher on the post-testing.

Laug also compared the men and women in the treatment of his data. The sex ratio of his sample was three females to one male for his experimental group. The men did slightly better than the women on both the pre-test and post-test, but the difference was insignificant. The difference on the

pre-test was 1.15 points and the difference on the post-test was 1.37 points.[1]

The "t" test was next employed to compare the difference between means of the pre-test and post-test of the two sexes. The data revealed that twenty-eight members of the class were women and thirty-five were men.

TABLE 10

t-TEST FOR CORRELATED MEAN DIFFERENCES OF EXPERIMENTAL MALE AND FEMALE GROUPS ON PRE- AND POST-TESTING

Testing Situation	Sex	N	Mean	$\bar{D}$	$\overline{SD}$	t
Pre-Test	Male	35	177.343			
Post-Test	Male	35	186.886	9.543	4.554	2.095**
Pre-Test	Female	28	181.357			
Post-Test	Female	28	189.821	8.464	3.816	2.218**

**Sig. at 5% level of Con.

$N_1 + N_2 - 2 = d_f$

$35 + 35 - 2 = 68 d_f$ (male)

$28 + 28 - 2 = 54 d_f$ (female)

Table of "t"

(male)	t - (.05) - 2.00 t - (.01) - 2.66
(female)	t - (.05) - 2.01 t - (.01) - 2.68

Upon entering the "t" table with sixty-eight degrees of freedom the resulting "t" of 2.095 for the males was short of significance at the 1% level of confidence but was significant at the 5% level. Upon entering the "t"

[1] Laug, op. cit., p. 94

table with fifty-four degrees of freedom for the females the observed "t" of 2.218 was declared not to be significant at the 1% level of confidence, but was significant at the 5% level. The null hypothesis was accepted as applying to both groups since the criterion of significance for this study was set at the 1% level of confidence.

In the study of Dr. Laug's findings it was learned that both the men and women were able to raise their scores by about the same amount. In the men there was a difference between means of 11.67 points and the women 11.45 points. In both groups there was significant difference between means at the 1% level of confidence.[1]

On the personal data sheet of the attitude scale the students were requested to indicate where they had lived for the greater part of their lives. The four possibilities were city, village, suburb and country. A village was designated as being a town of 2,500 people or less. The writer soon discovered that the recommended procedure was to combine village and country into one. These two were combined for the statistical treatment and the term rural was used. It was found that seventeen had an urban background, nine suburban and thirty-seven rural. Thus, the greater portion of the experimental class (60%) had been subjected to the rural type of environment for the greater part of their lives.

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[1]Laug, op. cit., p. 95.

These three groups were then compared first for the pre-test situation and again the "t" test for uncorrelated means was used. The treatment of this data yielded the following information:

TABLE 11

t-TEST FOR UNCORRELATED MEAN DIFFERENCES OF URBAN, SUBURBAN, AND RURAL STUDENTS ON PRE-TESTING

Residence Pairs	N	Mean	$\bar{D}$	$\overline{SD}$	t
Urban	17	173.058			
Suburban	9	180.880	7.882	5.553	1.419
Urban	17	173.058			
Rural	37	181.486	8.428	4.874	1.729
Suburban	9	180.880			
Rural	37	181.486	.606	4.819	.126

$N_1 + N_2 - 2 = d_f$

$17 + 9 - 2 = 24 d_f$ (Urb.-Sub.)

$17 + 37 - 2 = 52 d_f$ (Urb.-Rur.)

$9 + 37 - 2 = 44 d_f$ (Sub.-Rur.)

Table of "t"

(Urb.-Sub.)	t - (.05)	2.06
	t - (.01)	2.80
(Urb.-Rur.)	t - (.05)	2.01
	t - (.01)	2.68
(Sub.-Rur.)	t - (.05)	2.02
	t - (.01)	2.71

Upon entering the "t" table with twenty-four, fifty-two and forty-four degrees of freedom there was found to be no significant difference between means of any of the three combinations at either the 1% or 5% level of confidence.

The null hypothesis was accepted.

In the same pre-test study, Laug's data revealed that the suburban students were 3.74 points higher than the urban students; the rural were 9.80 points higher than the urban and the rural were 6.06 points higher than the suburban. There was no significant difference in his first comparison but the second and third groups had a difference between means that was significant.[1]

TABLE 12

t-TEST FOR UNCORRELATED MEAN DIFFERENCES OF URBAN, SUBURBAN, AND RURAL STUDENTS ON POST-TESTING

Residence Pairs	N	Mean	$\bar{D}$	$\overline{SD}$	t
Urban	17	179.117			
Suburban	9	182.110	2.993	7.104	.421
Urban	17	179.117			
Rural	37	193.837	14.720	5.076	2.90**
Suburban	9	182.110			
Rural	37	193.837	11.727	6.146	1.908

**Sig. at 1% level of Con.

$N_1 + N_2 - 2 = d_f$

$17 + 9 - 2 = 24 d_f$ (Urb-Sub)

$17 + 37 - 2 = 52 d_f$ (Urb-Rur)

$9 + 37 - 2 = 44 d_f$ (Sub-Rur)

Table of "t"

(Urb-Sub)	t - (.05) - 2.06 t - (.01) - 2.80
(Urb-Rur)	t - (.05) - 2.01 t - (.01) - 2.68
(Sub-Rur)	t - (.05) - 2.02 t - (.01) - 2.71

[1] Laug, op. cit., p. 83.

Upon entering the "t" table with twenty-four degrees of freedom for the urban-suburban groups the observed "t" was not significant at the 1% or 5% level of confidence. Upon entering the "t" table with fifty-two degrees of freedom for the urban-rural groups the "t" value of 2.90 was very significant at the 1% level of confidence as the rural group scored 14.720 points higher in the post-test than the urban group. Upon entering the "t" table with forty-four degrees of freedom for the suburban-rural groups the resulting "t" was just slightly short of significance at the 5% level of confidence. In the case of the first and third combination the null hypothesis was accepted and in the second case the null hypothesis was rejected, with the conclusion that there was a true difference between the two population means.

Laug's findings also revealed that there was a significant difference between means only in the case of the urban-rural groups. The difference between the means for this comparative study was 8.22 points in favor of the rural group.[1]

The writer was also interested in learning how the mean difference of each of these two groups would be affected by being subjected to the five-week conservation unit. The following table deals with this information:

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[1]Laug, op. cit., p. 85.

TABLE 13

t-TEST FOR CORRELATED MEAN DIFFERENCES OF URBAN, SUBURBAN, AND RURAL STUDENTS ON PRE- AND POST-TESTING

Residence	Test	N	Mean	$\bar{D}$	$\overline{SD}$	t
Urban	Pre	17	173.058			
	Post	17	179.117	6.059	5.909	1.025
Suburban	Pre	9	180.880			
	Post	9	182.110	1.230	6.811	.181
Rural	Pre	37	181.486			
	Post	37	193.837	12.351	3.822	3.231**

**Sig. at 1% level of Con.

$N_1 + N_2 - 2 = d_f$

17+ 17 -2 = $32d_f$ (Urban)

9+ 9- 2 = $16d_f$ (Suburb)

37+ 37- 2 = $72d_f$ (Rural)

Table of "t"

(Urban)	t - (.05) - 2.04
	t - (.01) - 2.75
(Suburb)	t - (.05) - 2.12
	t - (.01) - 2.92
(Rural)	t - (.05) - 2.00
	t - (.01) - 2.65

Upon entering the "t" table with thirty-two, sixteen and seventy-two degrees of freedom the observed "t's" for the urban and suburban groups were not significant at either the 1% or 5% level of confidence. In the case of the rural group the observed "t" of 3.231 was significant at the 1% level of confidence. The null hypothesis was accepted pertaining to the urban and suburban groups, but was refuted for the rural group. In the rural group there was a difference between the two means of 12.351 points and this was

considered to represent a true difference between the means.

The difference between the means was significant for all three of Laug's groups. He found the difference between the means of the pre-test and post-test to be 11.57 points for his urban group, 12.00 points for the suburban and 9.99 points for the rural.[1]

Geography was considered to be a course that included resource conservation in its contents and it was thought advisable to determine what effect it would have upon the students that had this subject in high school. The "F" table was used first to determine if the sample had equal variance.

TABLE 14

F-TEST FOR HOMOGENEITY OF EXPERIMENTAL GEOGRAPHY AND NO GEOGRAPHY POPULATIONS ON PRE- AND POST-TESTING

Testing Situation	Geography	N	Mean	S^2	F
Pre-Test	Yes	25	176.520	379.750	
Pre-Test	No	38	180.842	204.568	1.856**
Post-Test	Yes	25	184.280	323.958	
Post-Test	No	38	190.763	289.0	1.121

**Sig. at 5% level of Con.

$N_1 - 1 = d_f$	Table of "F"
24 and $37 d_f$	F - (.05) - 1.82 F - (.01) - 2.35

Upon entering the "F" table with twenty-four and thirty-seven degrees of freedom it was observed that neither of the resulting "F's" for the pre-test or post-test condition were significant at the 1% level of confidence. In the first case where the pre-test "yes" was compared with the pre-test "no" it was learned that the "F" was significant at the 5% level of confidence, but the margin was very slight being only .036 points above the 5% "F" value.

Further treatment of this data by the "t" technique is as follows:

TABLE 15

t-TEST FOR UNCORRELATED MEAN DIFFERENCES OF EXPERIMENTAL GEOGRAPHY AND NO GEOGRAPHY GROUPS ON PRE- AND POST-TESTING

Testing Situation	Geog.	N	Mean	$\bar{D}$	$\overline{SD}$	t
Pre-Test	Yes	25	176.520			
Pre-Test	No	38	180.842	4.322	4.535	.953
Post-Test	Yes	25	184.280			
Post-Test	No	38	190.763	6.483	4.534	1.430

$N_1 + N_2 - 2 = d_f$
$25 + 38 - 2 = 61 d_f$

Table of "t"

t - (.05) - 2.00
t - (.01) - 2.66

Upon entering the "t" table with sixty-one degrees of freedom it was determined that neither "t" was significant at the 1% or 5% level of confidence. Hence, the null hypo-

thesis was not refuted. In this sample then, those not having geography did better on both the pre-test and post-testing situations.

In the statistical treatment of his data, Dr. Laug did not choose to study the effects of having geography upon the attitude score of his students.

This data was then used to compare the "t" for correlated mean differences of those having had geography in high school and those not having this subject.

TABLE 16

t-TEST FOR CORRELATED MEAN DIFFERENCES OF EXPERIMENTAL GEOGRAPHY AND NO GEOGRAPHY GROUPS ON PRE- AND POST-TESTING

Geography	Test	N	Mean	$\bar{D}$	$\overline{SD}$	t
Yes	Pre-	25	176.520			
	Post-	25	184.280	7.760	5.306	1.463
No	Pre-	38	180.842			
	Post-	38	190.763	9.921	3.604	2.753**

**Sig. at 1% level of Con.

$N_1 + N_2 - 2 = d_f$

25+ 25- 2 = $48d_f$ (Yes)

38+ 38- 2 = $74d_f$ (No)

Table of "t"

(Yes) t - (.05) - 2.02
t - (.01) - 2.69

t - (.05) - 2.00
t - (.01) - 2.65

Upon entering the "t" table with forty-eight degrees of freedom for those who had geography and seventy-four

degrees of freedom for those who did not, the observed "t" for those that had the subject were not significant at either the 1% or 5% level of confidence. For those not having had the course the "t" was significant at the 1% level of confidence. This group was able to raise the mean by 9.921 points between the pre- and post-test. The null hypothesis was accepted in the first case but rejected in the second case. Both groups improved their scores after being subjected to the special conservation unit but only significantly so by the group that had not taken high school geography.

The effect of having had 4-H training was also of interest. This data was first subjected to the "F" test to check for homogeneity.

TABLE 17

F-TEST FOR HOMOGENEITY OF EXPERIMENTAL 4-H AND NO 4-H POPULATIONS ON PRE- AND POST-TESTING

Testing Situation	4-H	N	Mean	S^2	F
Pre-Test	Yes	17	181.176	284.0	
Pre-Test	No	46	178.369	273.844	1.037
Post-Test	Yes	17	193.176	269.0	
Post-Test	No	46	186.347	315.955	.851

$N_1 - 1 = d_f$
16 and 45 degrees of freedom

Table of "F"
F - (.05) - 1.88
F - (.01) - 2.44

Upon entering the "F" table with sixteen and forty-five degrees of freedom the "F" values in both of the above situations were not significant at the 1% or 5% level of confidence. The null hypothesis, thus, was not rejected.

This data was then treated by the "t" technique and the results appear in the following table:

TABLE 18

t-TEST FOR UNCORRELATED MEAN DIFFERENCES OF EXPERIMENTAL 4-H AND NO 4-H GROUPS ON PRE- AND POST-TESTING

Testing Situation	4-H	N	Mean	D	SD	t
Pre-Test	Yes	17	181.176			
Pre-Test	No	46	178.369	2.807	4.760	.590
Post-Test	Yes	17	193.176			
Post-Test	No	46	186.347	6.829	4.763	1.434

$N_1 + N_2 - 2 = d_f$

$17 + 46 - 2 = 61 d_f$

Table of "t"

t - (.05) - 2.00
t - (.01) - 2.66

Upon entering the "t" table with sixty-one degrees of freedom a "t" of .590 was obtained on the pre-test situation and a "t" of 1.434 on the post-test. In both cases the "t" falls below the level of significance at both the 1% and 5% level of confidence, and the null hypothesis was accepted. Those with 4-H training did better on both the pre-test and post-test.

Laug found that his students who were 4-H members did significantly better on the pre-test but not on the post-test. In the 4-H members there was a difference between means of 5.74 points on the pre-test and 4.22 points difference on the post-test.[1]

The following table was concerned with the data for correlated mean differences in a comparison of those having had 4-H training and those that did not.

TABLE 19

t-TEST FOR CORRELATED MEAN DIFFERENCES OF EXPERIMENTAL 4-H AND NO 4-H GROUPS ON PRE- AND POST-TESTING

4-H	Test	N	Mean	$\bar{D}$	$\overline{SD}$	t
Yes	Pre-	17	181.176			
	Post-	17	193.176	12.0	5.704	2.104**
No	Pre-	46	178.369			
	Post-	46	186.347	7.978	3.581	2.228**

**Sig. at 5% level of Con.

$N_1 + N_2 - 2 = d_f$
$17 + 17 - 2 = 32 d_f$ (Yes)
$46 + 46 - 2 = 90 d_f$ (No)

Table of "t"

(Yes)	t - (.05) - 2.04	
	t - (.01) - 2.75	
(No)	t - (.05) - 1.99	
	t - (.01) - 2.63	

Upon entering the "t" table with thirty-two and ninety degrees of freedom, the resulting "t's" were short of

[1]Laug, op. cit., p. 99.

significance at the 1% level, but were both significant at the 5% level of confidence. Since the 1% level of confidence was adopted as the criterion for significance for this study and 5% was considered as questionable significance, the null hypothesis was accepted and it was concluded that there was not a significant difference between the means in either the pre- or post-testing situation. Those members of the group that had the 4-H experience raised their score on the attitude scale by 12.00 points and those lacking this training raised theirs by 7.978 points.

Laug discovered from his "t" values that both the above groups had a difference between means that were significant at this required 1% level of confidence. The 4-H group raised their mean by 10.14 points and the non-4-H members by 11.66 points.[1]

It was learned from the personal data questionnaire that twenty-nine had been to summer camp and thirty-four had not. In checking this data the "F" test for homogeneity was first run.

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[1]Laug, op. cit., p. 100.

TABLE 20

F-TEST FOR HOMOGENEITY OF EXPERIMENTAL SUMMER CAMP AND NO SUMMER CAMP POPULATIONS ON PRE- AND POST-TESTING

Testing Situation	Summer Camp	N	Mean	S^2	F
Pre-Test	Yes	29	183.655	239.536	
Pre-Test	No	34	175.268	277.485	.863
Post-Test	Yes	29	192.310	214.286	
Post-Test	No	34	184.676	369.394	.580

	Table of "F"
$N_1 - 1 = d_f$	
28 and 33 degrees of freedom	F - (.05) - 1.86 F - (.01) - 2.42

Upon entering the "F" table with twenty-eight and thirty-three degrees of freedom, neither of the observed "F" values were significant at the 1% or 5% level of confidence, and the null hypothesis was not rejected.

The "t" technique was then employed to compare these two groups of students on both the pre- and post-testing situations.

TABLE 21

t-TEST FOR UNCORRELATED MEAN DIFFERENCES OF EXPERIMENTAL SUMMER CAMP AND NO SUMMER CAMP GROUPS ON PRE- AND POST-TESTING

Testing Situation	Summer Camp	N	Mean	$\bar{D}$	$\overline{SD}$	t
Pre-Test	Yes	29	183.655			
Pre-Test	No	34	175.264	8.391	4.052	2.071**
Post-Test	Yes	29	192.310			
Post-Test	No	34	184.676	7.634	4.272	1.787

**Sig. at 5% level of Con.

$N_1 + N_2 - 2 = d_f$
29+ 34- 2 = 61 degrees of freedom

Table of "t"

t - (.05) - 2.00
t - (.01) - 2.66

Upon entering the "t" table with sixty-one degrees of freedom, the observed "t"'s were found to lack significance at the 1% level of confidence but in the pre-testing situation the "t" was significant at the 5% level of confidence.

On the basis of these results the writer failed to reject the null hypothesis.

The data was then treated by means of the "t" technique for correlated mean differences for both groups.

TABLE 22

t-TEST FOR CORRELATED MEAN DIFFERENCES OF EXPERIMENTAL SUMMER CAMP AND NO SUMMER CAMP GROUPS ON PRE- AND POST-TESTING

Summer Camp	Test	N	Mean	$\bar{D}$	$\overline{SD}$	t
Yes	Pre-	29	183.655			
	Post-	29	192.310	8.655	3.956	2.188**
No	Pre-	34	175.264			
	Post-	34	184.676	9.412	4.362	2.158**

**Sig. at 5% level of Con.

$N_1 + N_2 - 2 = d_f$

29+ 29- 2 = $56d_f$ (Yes)

34+ 34- 2 = $66d_f$ (No)

Table of "t"

(Yes) t - (.05) - 2.01
t - (.01) - 2.68

(No) t - (.05) - 2.00
t - (.01) - 2.66

Upon entering the "t" table with fifty-six degrees of freedom for those having had summer camp and sixty-six degrees of freedom for those without this experience, both "t" turned out to be significant at the 5% level of confidence but were not significant at the 1% level. The results failed to refute the null hypothesis.

Dr. Laug did not subject his summer camp experience data to statistical treatment.

Next, the data was subjected to statistical treatment to determine if the training received in scouting would have any effect upon attitudes in conservation.

The girl scout situation was first studied. It was found that only seven out of the twenty-eight girls in the class had been girl scouts. These numbers are lower than preferred for the "F" and "t" test but the writer decided to check this data for significance.

First, the "F" test for homogeneity of variance was applied.

TABLE 23

F-TEST FOR HOMOGENEITY OF EXPERIMENTAL GIRL SCOUTS AND NO GIRL SCOUTS POPULATIONS ON PRE- AND POST-TESTING

Testing Situation	Girl Scouts	N	Mean	S^2	F
Pre-Test	Yes	7	178.0	105.667	
	No	21	182.476	212.350	.498
Post-Test	Yes	7	186.280	199.50	
	No	21	191.0	235.30	.848

$N_1 - 1 = d_f$
6 and 20 degrees of freedom

Table of "F"
F - (.05) - 2.60
F - (.01) - 3.87

The "F" table was entered with six and twenty degrees of freedom and in both cases the resulting "F" was not significant at the 1% and 5% level of confidence. Thus, the null hypothesis was not rejected.

This data was then treated by the "t" technique for uncorrelated mean differences in a comparison of the pre- and post-testing situations.

TABLE 24

t-TEST FOR UNCORRELATED MEAN DIFFERENCES OF EXPERIMENTAL GIRL SCOUTS AND NO GIRL SCOUTS GROUPS ON PRE- AND POST-TESTING

Testing Situation	Girl Scouts	N	Mean	$\bar{D}$	$\overline{SD}$	t
Pre-Test	Yes	7	178.0			
	No	21	182.476	4.476	5.021	.891
Post-Test	Yes	7	186.280			
	No	21	191.0	4.720	6.302	.749

$N_1 + N_2 - 2 = d_f$
$7 + 21 - 2 = 26$ degrees of freedom

Table of "t"
$t - (.05) - 2.06$
$t - (.01) - 2.78$

Upon entering the "t" table with twenty-six degrees of freedom, "t" values of .891 and .749 were obtained of which lack significance at the 1% or 5% level of confidence. The null hypothesis was accepted.

Laug found that the women in his class who had been girl scouts did a little better on both the pre- and post-test situations but the difference was not significant in either case. The difference was 2.62 points on the pre-test and 2.56 points on the post-test.[1]

[1] Laug, op. cit., p. 105.

The two groups were then studied for significance of the difference between the means of the pre-test and the post-test. The "t" test for correlated means was employed.

TABLE 25

t-TEST FOR CORRELATED MEAN DIFFERENCES OF EXPERIMENTAL GIRL SCOUTS AND NO GIRL SCOUTS GROUPS ON PRE- AND POST-TESTING

Girl Scouts	Test	N	Mean	D	SD	t
Yes	Pre-	7	178.0			
	Post-	7	186.280	8.280	6.603	1.254
No	Pre-	21	182.476			
	Post-	21	191.0	8.524	4.617	1.846

$N_1 + N_2 - 2 = d_f$

$7 + 7 - 2 = 12 d_f$ (Yes)

$21 + 21 - 2 = 40 d_f$ (No)

Table of "t"

(Yes)	t - (.05) - 2.18
	t - (.01) - 3.06
(No)	t - (.05) - 2.02
	t - (.01) - 2.71

Upon entering the "t" table with twelve degrees of freedom for those having girl scout training and forty degrees of freedom for those not having this training, the observed "t" was both found to lack significance at the 1% and 5% level of confidence. The findings failed to refute the null hypothesis. Both groups were observed to raise their scores by slightly over eight points.

Laug observed a significant difference between means in both of the above two groups. The women with the girl

scout training had a difference between the means of the pre- and post-test of 11.43 points and those lacking in this type of training had a difference of 11.49 points.[1]

The last part of this investigation was a study of the effect of boy scout training upon attitudes in conservation. Seventeen out of the thirty-five men in the class had such training. First, the "F" test for homogeneity was applied.

TABLE 26

F-TEST FOR HOMOGENEITY OF EXPERIMENTAL BOY SCOUTS AND NO BOY SCOUTS POPULATIONS ON PRE- AND POST-TESTING

Testing Situation	Boy Scouts	N	Mean	S^2	F
Pre-Test	Yes	17	178.058	312.688	
	No	18	176.667	394.588	.792
Post-Test	Yes	17	187.294	480.875	
	No	18	186.50	308.765	1.557

	Table of "F"
$N_1 - 1 = d_f$	
16 and 17 degrees of freedom	F - (.05) - 2.29 F - (.01) - 3.27

Upon entering the "F" table with sixteen and seventeen degrees of freedom the resulting "F" was not significant at either of the levels of confidence. The writer failed to

[1] Laug, op. cit., p. 105.

reject the null hypothesis.

This data was then treated by the "t" technique for uncorrelated mean differences between the pre-test and post-test situations.

TABLE 27

t-TEST FOR UNCORRELATED MEAN DIFFERENCES OF EXPERIMENTAL BOY SCOUTS AND NO BOY SCOUTS GROUPS ON PRE- AND POST-TESTING

Testing Situation	Boy Scouts	N	Mean	$\bar{D}$	$\overline{SD}$	t
Pre-Test	Yes	17	178.058			
	No	18	176.667	1.392	6.349	.219
Post-Test	Yes	17	187.294			
	No	18	186.50	.794	6.741	.118

$N_1 + N_2 - 2 = d_f$
17+ 18- 2 = 33 degrees of freedom

Table of "t"
t - (.05) - 2.04
t - (.01) - 2.75

Upon entering the "t" table with thirty-three degrees of freedom the obtained "t's" were found to be insignificant at the 1% and 5% level of confidence resulting in the acceptance of the null hypothesis that the compared means could have come from a common population. The men with scouting experience did just slightly better on both the pre-test and post-test over those not having had this training.

In Laug's findings the difference between means in both the pre-test and post-test comparison was not significant.

Those who were active in boy scouting did 1.48 points better on the pre-test and 2.02 points better on the post-test. Neither of these differences were significant.[1]

The last analysis of the data was concerned with correlated mean differences of those who were boy scouts and those who were not. The following table contains this data:

TABLE 28

t-TEST FOR CORRELATED MEAN DIFFERENCES OF EXPERIMENTAL BOY SCOUTS AND NO BOY SCOUTS GROUPS ON PRE- AND POST-TESTING

Boy Scouts	Test	N	Mean	$\overline{D}$	$\overline{SD}$	t
Yes	Pre-	17	178.058			
	Post-	17	187.294	9.236	6.832	1.352
No	Pre-	18	176.667			
	Post-	18	186.50	9.834	6.251	1.573

$N_1 + N_2 - 2 = d_f$

17+ 17- 2 = $32d_f$ (Yes)

18+ 18- 2 = $34d_f$ (No)

Table of "t"

(Yes) t - (.05) - 2.04
t - (.01) - 2.75

(No) t - (.05) - 2.04
t - (.01) - 2.75

Upon entering the "t" table with thirty-two and thirty-four degrees of freedom the observed "t" was not significant at either levels. The null hypothesis was accepted. It was

[1] Laug, op. cit., p. 102.

noted, however, that both groups were able to raise their scores by more than nine points.

In Laug's boy scout and non-boy scout groups there was a significant difference between the means of the pre-test and post-test. The scouts had a difference of 11.87 points and the non-scouts a difference of 11.33 points.[1]

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[1]Laug, op. cit., p. 103.

CHAPTER V

SUMMARY AND CONCLUSIONS

I. A Brief Review of the Study

With the rapid increase in the human population taking place in the world today, resulting in an increased demand upon our resource base, the writer believes that all college students should be introduced to resource conservation. Somewhere in the curriculum planning of the liberal arts college this topic should be integrated into the course of study.

The writer, having taught conservation on the campus of Spring Arbor College for several years, was drawn toward the present study by a recurring question: Are we actually accomplishing the goals we have set up in the structuring of the course entitled Conservation? To determine what effects the teaching of conservation has upon the student, it was decided to make such a determination by means of an attitude scale rather than making use of a traditional test of subject-matter knowledge. A special unit was developed and the Spring Arbor College freshman biology class was chosen for the experiment. The unit was a general one, with an ecological approach, of five-weeks duration.

The second semester introductory biology class was designated as the experimental group, and thus were exposed to the conservation unit. Information from the personal data

sheet revealed that fifty-seven members of the class were freshmen, five were sophomores and one was a junior. In regards to age, thirty-five were eighteen years old, seventeen were nineteen years of age, four were twenty and the remaining seven students were twenty-one or older.

Two control groups were used by the writer. These were the first semester biology classes at Spring Arbor College and Northwestern College at Orange City, Iowa. Neither of these groups was subjected to the five-week conservation unit but were taught the material contained in the conventional biology course.

In Dr. Laug's experiment, with which the writer compared his findings, a two-week unit was presented to his biology classes with much stress upon the field experience where each student actually spent one or two days in the field on some conservation project. Most students were involved in the planting of trees and shrubs to provide food and cover for wildlife. His classroom work was supplemented with handout sheets, most of which pertained to the field experience which he had planned to stress.

The attitude scale used as the testing instrument in this investigation was the one developed by Dr. Laug while doing graduate study at Syracuse University. It was a Likert-type test, with statements written in a language that could be easily understood by students on the college freshman level.

II. Guide to Interpretation

This study was not concerned with individual diagnosis but involved itself in the analysis of the difference between the means for the groups. The amount of the difference, its direction and significance were also of interest. In this study it was assumed that the higher the score obtained by the student the more favorable the attitude. The "F" test was used to establish homogeneity of variance for uncorrelated groupings of students, and the "t" test for significance of difference between means. For comparison with Laug's study, the 1% level of confidence was adopted as the criterion of significance. At the same time, findings at the 5% level of confidence was considered to have meaning for this study.

III. Major Conclusions

The first concern of this investigation was to determine if an exposure to a unit in conservation by the experimental group did bring about a measurable change in attitudes in a favorable direction. To ascertain this, the difference between the means of the pre- and post-test was determined and then treated by means of the "t" technique to determine if the computed difference was significant or not. There was demonstrable evidence that the experimental group, in general, did profit by the experience as it was established, and that the difference was significant.

Dr. Laug noted similar results pertaining to significance by the use of his "learning by doing" approach to the topic of conservation.

From these two independent studies, one of which was conducted on a State University campus in New York and the other on the campus of a small private liberal arts college in Michigan, it has been concluded that the exposing of college freshmen biology students to the principles of conservation results in a positive change in attitudes toward conservation concepts.

It also appeared to be established that Dr. Laug and the present writer were working with groups of similar backgrounds and training although the samplings were from different geographical areas. There was a difference of only 0.65 points between the means of the pre-tests of Laug's experimental group and that of the writer's

A second concern was to determine how the results of the two control groups compared with those of the experimental group. It was evident that little change in attitudes took place in these two control groups as neither showed a significant change between the mean of the pre-test and the mean of the post-test. The Spring Arbor group had a 3.309 point rise in the mean but the Northwestern sample underwent a 1.642 change in a negative direction. Laug's control group responded similarly to the Northwestern College control group with a computed change in the negative direction of 3.160 points between the means. As a result of these find-

ings, it has been assumed that the teaching of the conventional type biology course has little effect upon the formation of favorable attitudes toward resource conservation.

A third point of interest centered around the results of comparisons of the Spring Arbor College experimental and control groups in pre- and post-test situations. The means for the two groups were very similar on the pre-test, with a difference of 0.289 points, which in statistical analysis proved to be insignificant. On the post-test comparison a significant difference was found at the 5% level of confidence. The experimental group had a higher mean than the control group, 6.043 points, on the post-test comparison. From this data we have concluded that the attitude scale ratings of both study groups were close or comparable at the beginning of their course in biology and that the improvement was most pronounced in the experimental group.

IV. Related Conclusions

Further conclusions center around specific study and statistical treatment of the experimental group.

The effect of sex upon existing attitudes and possible change in attitudes was studied. The women had a slightly higher score than the men on both the pre- and post-test comparison, but the computed difference was not significant. Dr. Laug found that the men accumulated higher scores than the women in pre- and post-testing situations, but the difference was not significant.

It was apparent that the attitudes of the two sexes were about the same at the time of pre-testing. An improvement due to being exposed to a unit on the principles of conservation was noted with the change being about the same for both sexes .

Analysis of the scores of both sexes revealed gains on their scores which were significant at the 5% level, but fell short of the 1% level of confidence. Laug found the same to be true of his group, but with larger numbers in the sample, his results were significant at the 1% level for both sexes.

The data concerning the possible effects of different environmental backgrounds revealed no significant differences between the three groups, urban, suburban and rural, on the pre-test situation; however, according to the post-test data the rural segment of the group scored significantly higher than the urban group at the 1% level of confidence. The rural group, however, fell short of significance at the 5% level of confidence over the suburban group. The correlated "t" technique showed that the rural group had the greatest score increase following the instruction in conservation and was the only group of the three to show significant change between the means of the pre- and post-test. The urban group profited somewhat and the suburban group profited the least. The writer, however, hesitated to draw any conclusions pertaining to the suburban group as it contained only nine members, a low figure to permit the determination of significance

by means of the "t" test.

After a study of his data, Laug concluded that his rural students had higher attitude scores than either the urban or suburban students at the time of pre-testing. In the post-testing situation the mean of rural students was significantly higher than that of the urban students, but not significantly higher than the suburban students. An application of the correlated "t" technique showed all three of his groups improving their mean scores at the 1% level of significance from the pre- to the post-testing situation.

The personal data sheet revealed that twenty-five members of the class had completed a high school course in geography. These students were compared with those not having completed such a course. While those without the geography scored slightly higher on both pre-and post-testing comparisons, differences were not significant. Those not having taken geography in high school showed a gain of 9.921 points between the times of the pre- and post-test, and this difference proved to be significant at the 1% level of confidence. Those that had taken this subject also profited by the exposure to the conservation unit but the difference of 7.760 was not found to be a significant one statistically. Dr. Laug did not study the factor of high school geography so that no comparisons with his findings could be made.

One-third of the class had 4-H training, and these members were compared with the other members of the class

not having this experience. The 4-H program appeared to have been of benefit, for their scores were higher on both the pre-test and post-test than those lacking this training. The difference, however, was not great enough to be statistically significant in either case. On the pre-test comparison, Laug's 4-H group showed a significant difference over the group that did not have 4-H. The writer's analysis of the statistical treatment for correlated mean difference revealed that both groups showed a significant difference at the 5% level, but fell short of the 1% level of confidence. It appeared in the present study that the 4-H training had some value in producing desirable attitudes toward resource conservation concepts, a conclusion that is in agreement with the findings of Laug.

Twenty-nine members of the class had at some time spent a summer in some type of camp. Those having such experience scored significantly higher (at the 5% level) on the pre-test than the members of the class that had not attended a summer camp. They also scored higher on the post-test comparison, but the difference was not statistically significant. The correlated "t" technique showed a significant gain in the mean at the 5% level from the pre- to the post-testing situation for both groups. It may be assumed from these findings that summer camp attendance had some value in bringing about favorable changes in attitudes. Dr. Laug did not analyze this characteristic.

The statistical treatment of the data pertaining to the value of boy and girl scout training revealed that such training produced no significant effect upon attitude changes. No statistical significance was detected in regards to a comparison of the pre-test or post-testing situations, as gains fell short of significance at the 5% level of confidence. Laug's results were similar on the pre- and post-test comparisons although both the girl scout and boy scout trainees showed a significant gain between the means of the pre-test and those of the post-test.

V. Limitations of This Study

There are some apparent limitations to a study of this nature. First, in a study of attitudes it is necessary to start with several assumptions. The assumptions that Remmers makes are that attitudes are measurable, that they vary along a linear continuum, that measurable attitudes are common to the group and that they are held by many people.[1]

Second, it would have been desirable to have had larger numbers with which to work, but the "t" formula used has a built-in factor that takes into consideration the size of the N. Garrett defines a large sample as one with an N of thirty or more.[2]

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[1]Remmers, op. cit., p. 71.

[2]Garrett, op. cit., p. 186.

The number of individuals in the three sample groups used were sixty-eight, sixty-three and forty-two. While these three are above thirty, the N fell in some cases below this number when comparisons were made of characteristics of the group.

Third, the problem of rationalization enters the picture in a study of this type, even though the groups were given careful instruction that the test was not one of knowledge and no grade would be recorded. They were instructed to express only how they felt about each item on the scale. It is hoped that students have been able to follow these instructions, but perhaps it would be best to refer to the findings, as Dr. Laug chose to do, as "expressed attitudes."

VI. Recommendations for Further Research

This study endeavored to determine whether it is possible to change attitudes toward conservation concepts by the teaching of principles. Since it appears from the findings of Dr. Laug and the writer that the class mean can be raised by this teaching method, it might also be of interest to learn whether the class mean could be raised even higher by including attitudes as a part of course objectives. When we analyze course objectives we find that attitudes are an important part of many statements of instructional objectives. Objectives of this nature, however, were avoided in the present study.

The permanence of attitude change is also in need of further investigation. To test this durability it would be of interest to retest the experimental group one or two years later with the same testing instrument to learn if any change has come about with time. Because of drop-outs and transfers this might prove to be difficult to do, but no doubt a sufficient number of students would return to give a good indication as to whether a change in attitudes had taken place.

Since scientific findings are worth little unless other investigators are able to verify the results, the writer believes it would be desirable for others with sufficient interest to conduct an investigation similar to the present one, using Dr. Laug's attitude scale as the testing instrument.

BIBLIOGRAPHY

I. Books

Arkin, Herbert and Raymond R. Colton, Tables for Statisticians (New York: Barnes and Noble, Inc., 1950).

Cheyney, E. G. and T. Schantz-Hansen, This Is Our Land (Saint Paul: The Webb Publishing Co., 1950).

Dasmann, Raymond F., Environmental Conservation (New York: John Wiley & Sons, 1959).

Edwards, Allen E., Techniques of Attitude Scale Construction (New York: Appleton-Century-Crofts, 1957).

Garrett, Henry E., Statistics in Psychology and Education (New York: Longmans, Green & Co., 1926).

Guilford, J. P., Fundamental Statistics in Psychology and Education (2d.ed. New York: McGraw-Hill Book Co., 1950).

Hardin, Garrett, Biology, Its Principles and Implications (San Francisco: W. H. Freeman & Co., 1961).

Highsmith, Richard M., Jr., J. Granville Jensen and Robert D. Rudd, Conservation in the United States (Chicago: Rand McNally & Co., 1962).

Lively, Charles E. and Jack J. Preiss, Conservation Education in American Colleges (New York: The Ronald Press, 1957).

Mudd, Stuart, ed., The Population Crisis and the Use of World Resources ("World Academy of Art and Science," No. 2; Bloomington, Indiana: Indiana University Press, 1964).

Odum, Eugene P., Fundamentals of Ecology (2d.ed., Philadelphia: W. B. Saunders Co., 1959).

Ordway, Samuel, Resources and the American Dream (New York: The Ronald Press, 1953).

Remmers, H. H., Introduction to Opinion and Attitude Measurement (New York: Harper & Brothers, 1954).

Remmers, H. H. and N. L. Gage, Educational Measurement and Evaluation (rev.ed.: New York: Harper and Bros., 1955).

Selltiz, Claire, et al, Research Methods in Social Relations (rev.ed.: New York: Holt, Rinehart and Winston, 1959).

Simonson, Roy W., "What Soils Are," Yearbook of Agriculture (Washington: U. D. Government Printing Office, 1957).

II. Documents, Articles, Periodicals and Catalogs

Barrett, Paul, Conservation, A Responsibility of Our Schools, Conservation Bulletin No. 5, Vol. 2 (East Lansing: Michigan State College, 1953).

The Conservation Foundation, in co-operation with Educational Testing Service of Princeton, New Jersey, Test of Reasoning in Conservation (New York: The Conservation Foundation, 1961).

Fersh, George L., Focal Responsibility of Our Times, An address delivered at the Convention of Texas Soil Conservation District Supervisors, Galveston, Texas, January 13-15, 1960 (New York: Joint Council on Economic Education).

Fersh, George L., A Design for Learning, An address delivered at the Michigan Leadership Conference, Ann Arbor, Michigan, January 23, 1960 (Ypsilanti: Eastern Michigan University).

Giles, Robert H., Jr., Conservation Knowledge of Virginia School Pupils, Virginia Polytechnic Institute and the United States Department of Agriculture cooperating, Bulletin No. 257 (Blacksburg, Va.; Extension Service, 1958).

Laug, George M., "Do It Yourself Conservation and Its Effect Upon Attitudes of Prospective Teachers," The American Biology Teacher, Vol. XXIV (January, 1962).

Likert, Rensis, "A Technique for the Measurement of Attitudes," Archives of Psychology, No. 140 (June, 1932)

Catalog of Northwestern College, 1963-64.

Catalog of Spring Arbor College, 1963-64.

Swift, Ernie, "Straight Talk," National Wildlife, January-February, 1964.

United Nations Office of Public Information, Population and Food Supply, August, 1962.

III. Unpublished Materials

Laug, George Milton, "A study of Expressed Attitudes of Prospective Teachers Taking Part in Practical Conservation Activities," (unpublished Ph.D. dissertation, Syracuse University, 1960).

Wievel, Bernard F., "Attitude Toward and Knowledge of Conservation Possessed by Students in Iowa High Schools" (unpublished Ph.D. dissertation, Iowa State College, 1947).

APPENDIX A

The Attitude Scale

PERSONAL DATA QUESTIONNAIRE

1-3. Number_____ 4-9. Date_____ 10-11. Age_____ 12. Sex_____

13. Name of College_____ 14. Year in College_____

15. I have lived the greater part of my life in

(1) City_____ (2) Village_____ (3) Suburbs_____ (4) Country_____

16. My grades are

(1) Above average_____ (2) Average_____ (3) Below average_____

Check the courses which you have taken prior to this year and also those which you are now taking. Place (H) in front of the course in question if it was a high school course and (C) for college. If a course was taken both in high school and in college use both (H) and (C).

Courses

_____	17 General Science	_____	25 Biology
_____	18 Nature Study	_____	26 Zoology
_____	19 Natural Science	_____	27 Botany
_____	20 General Agriculture	_____	28 Physics
_____	21 Vocational Agriculture	_____	29 Civics
_____	22 Industrial Arts	_____	30 Chemistry
_____	23 Home Economics	_____	31 Geography
_____	24 Physiology	_____	32 Sociology

Check those of the following activities in which you have participated.

_____	33 4-H Club	_____	38 Conservation Clubs
_____	34 Summer Camp	_____	39 Nature Photography
_____	35 Boy Scouts	_____	40 Bird Clubs
_____	36 Girl Scouts	_____	41 Nature Camps
_____	37 Camp Fire Girls	_____	42 Hiking Clubs

ATTITUDE TOWARD CONSERVATION

We are concerned with your opinions regarding conservation. If this questionnaire is to be of any value, your responses **must** be honest. This is not a test and you will not be graded. For each of the following statements, encircle the letter or letters which most closely represent **your** idea concerning that statement. Do not respond as you think you **should** but instead according to how you feel personally.

SA—Strongly agree; A—Agree; U—Undecided; D—Disagree; SD—Strongly disagree

SA A U D SD	43.	Progress in our country will be retarded if we use strong conservation measures.
SA A U D SD	44.	A man should be allowed to use his land as he sees fit.
SA A U D SD	45.	Conservation of our forests is not necessary as we already have substitutes for wood.
SA A U D SD	46.	Hunting is very poor conservation.
SA A U D SD	47.	Conservation seems foolish when our standard of living is constantly rising.
SA A U D SD	48.	It would be wise for the government to support a strong soil conservation program.
SA A U D SD	49.	The fox kills pheasants, therefore it would be wise to destroy all foxes.
SA A U D SD	50.	In the Northeast, for the last several decades, the area returned to forest has exceeded the area cleared, therefore we will soon have plenty of timber.
SA A U D SD	51.	Forest conservation means that we should save as many trees as possible until they are needed.
SA A U D SD	52.	If we could reforest all denuded land, we would prevent floods.
SA A U D SD	53.	We should destroy all undesirable species of plants and animals in order that the most desirable species will thrive.
SA A U D SD	54.	Science will be able to find a substitute for most resources when the original supply is exhausted.
SA A U D SD	55.	Farmers who practice poor conservation should be forced by the government to improve their methods.
SA A U D SD	56.	Flood control is most effectively achieved by building many large flood control dams on our larger rivers.
SA A U D SD	57.	River mouths can best be kept free of mud by using better dredging equipment.
SA A U D SD	58.	The public schools of our nation do not spend enough time in the teaching of conservation.
SA A U D SD	59.	Conservation of natural resources is so slow in its results that in a lifetime it can hardly benefit a person now alive.
SA A U D SD	60.	Conservation should be a very important area in the teaching of biology.
SA A U D SD	61.	For persons living in the city soil conservation has little importance.
SA A U D SD	62.	Conservation is a form of socialism.
SA A U D SD	63.	We are an extremely wasteful nation.
SA A U D SD	64.	I consider conservation to be a minor area in the education of the average citizen for everyday living.
SA A U D SD	65.	Effective conservation practice would endanger the personal liberty of a man.
SA A U D SD	66.	Conservation measures are of great importance to hunters.
SA A U D SD	67.	Farming today is a big business and if farmers used conservation measures on their land their profits would be cut.

SA A U D SD	68.	Private business interests are responsible for many poor conservation practices.
SA A U D SD	69.	The government should recommend the number and size of trees which can be cut on private land.
SA A U D SD	70.	If the number of game animals in an area should become depleted, as for example deer, we can restock the area from an outside area.
SA A U D SD	71.	The waste of our resources is an illustration of extreme inconsideration and selfishness.
SA A U D SD	72.	The government should spend larger sums of money on erosion control.
SA A U D SD	73.	Soil erosion is no great problem in most sections of the country.
SA A U D SD	74.	The subject of conservation just doesn't interest me.
SA A U D SD	75.	Many conservation minded people are too cautious and stand in the way of progress.
SA A U D SD	76.	Conservationists in general are alarmists.
SA A U D SD	77.	Wildlife is of very little concern to me as it plays very little part in my everyday life.
SA A U D SD	78.	Conservationists say that a number of wild game species, such as deer, are increasing in the Northeast. This proves that they have been alarmists in their predictions in the past.
SA A U D SD	79.	Conservation is important but you can't change human nature.
SA A U D SD	80.	Poor conservation is weakening our position as a world power.
SA A U D SD	43b.	I am only concerned with our present standard of living. Future generations will be able to take care of their own.
SA A U D SD	44b.	There is little I can do regarding conservation; I am only one person.
SA A U D SD	45b.	Many businesses are against conservation measures because they feel the measures will restrict their activities.
SA A U D SD	46b.	When resources are used up in one area we can always move on to other areas.
SA A U D SD	47b.	When a forest is managed for conservation purposes, it means that no trees should be cut.
SA A U D SD	48b.	If as students, we take part in conservation measures, it will have little value for us as we will not see the results of our labor while we are students.
SA A U D SD	49b.	I would rather engage in social activities than spend some of my own time furthering the cause of conservation.
SA A U D SD	50b.	If a person is not interested in conservation, he should not have to spend time learning about it.
SA A U D SD	51b.	Since our forefathers did not practice conservation, we see no reason why we should.
SA A U D SD	52b.	In case of forest fire, the authorities should be able, with a few limitations, to call on anyone to help fight it.
SA A U D SD	53b.	The harvesting of timber, even on private land should be strictly regulated by the government.
SA A U D SD	54b.	An effective method to bring about conservation measures is to prove to the farmer that they will make the farmer more prosperous.
SA A U D SD	55b.	The greatest enemy of conservation is indifference on the part of people.
SA A U D SD	56b.	If we want a healthy deer population, we should prohibit all hunting of deer.
SA A U D SD	57b.	Soil erosion is a major problem in this country.
SA A U D SD	58b.	I feel that if we do not take effective conservation measures in our country, we may eventually decline as a major power.

SA	A	U	D	SD	59b.	Water resources in our country should be classified as to the degree of pollution which would be possible for the use to which the water would be put.
SA	A	U	D	SD	60b.	Floods in most river valleys could largely be controlled by digging the river channel deeper.
SA	A	U	D	SD	61b.	Hunters and fishermen as a group are generally against conservation.
SA	A	U	D	SD	62b.	Prevention of waste within the home falls in the area of conservation.
SA	A	U	D	SD	63b.	Willful waste is a crime against humanity.
SA	A	U	D	SD	64b.	To practice conservation within the home is too time consuming.
SA	A	U	D	SD	65b.	The study of conservation in the field is generally more effective than studying it in the classroom.
SA	A	U	D	SD	66b.	Healthy land means healthy people.
SA	A	U	D	SD	67b.	Farmers often use poor farming practices because their forefathers also used poor farming practices.
SA	A	U	D	SD	68b.	Human nature is such that we can never educate people to save for tomorrow.
SA	A	U	D	SD	69b.	I don't know anything about living things such as trees, and therefore conservation doesn't interest me.
SA	A	U	D	SD	70b.	If farmers don't use conservation measures, their land ought to be ruined.

APPENDIX B

Letter of Permission to Use the Scale

State University

COLLEGE OF EDUCATION

Buffalo, New York

(A copy)

Science Department

To Whom it May Concern,

This letter is to state that Mr. Eldon E. Whiteman has my permission to use the attitude scale which was constructed for the dissertation "A Study of Expressed Attitudes of Prospective Teachers, Taking Part in Practical Conservation Activities" Ph.D. at Syracuse University. He may also improve the format to fit his purposes.

Sincerely,

George M. Laug
Associate Prof.
of Biology

APPENDIX C

The Course Outline and Reading Assignments for Conservation Unit

NATURAL SCIENCE 100

Course Outline

Natural Science 100 is a one-semester course meeting for three lectures and one double laboratory period a week. Visual aids will be used in some of the laboratory sessions after which the class will be divided into small groups for discussion of the subject presented.

As a resource study, there will be one all-day field trip to the Kellogg Bird Sanctuary and Kellogg Forest Area.

The texts used in this course are as follows:

Brown, Relis B. Biology
Dasmann, Raymond F. Environmental Conservation

The course outline:

Part I: The Nature of Biological Science

A. Introduction to Biological Science and Course Objectives
B. Introduction to the Literature and Men in Biological Science
C. Procedure in Science
D. Limitations of Science

Part II: The Nature of Life

A. Characteristics of Living Things
B. The Cell
C. Growth (Cell Division)
D. Sexual and Asexual Reproduction
E. Genetics
F. How Living Things are Classified
G. The Animal Kingdom
H. Evolution
I. The Plant Kingdom

Part III: Perpetuation of Life and Resources

A. The population Resource Problem
B. Nature and History of Resources
C. Introduction to Ecology
D. Biotic Regions of North America
E. Soils and Food
F. Water
G. Forests
H. Wildlife
I. Conservation of Environment
J. The Future Outlook

NATURAL SCIENCE 100

Reading Assignments for Conservation Unit

Date	Subject	Assignment
4/22/64	Population	Text: Chapter 11 Reserve reading: Population and Food Supply, pp. 1-18.
4/24	Nature of Resources	Reserve Reading: Concepts of Conservation, pp. 5-9. Study Bulletin, "Our Native Land."
4/27	Ecology	Text: Chapter 1
4/29	Biotic Regions of North America	Text: Chapter 2
5/1	Soils	Text: Chapter 4 Reserve Reading: Soils of Michigan, pp. 8-16 Reserve Reading: Soils by Charles E. Kellogg: maps on pp. 2, 3 and 4; drawing p. 7.
5/6	Water	Text: Chapter 5 Reserve Reading: The Struggle for Clean Water, pp. 1-12. Handout: "Kalamazoo Watershed"
5/8	Test	Population, Ecology, Biotic Regions and Soils.
5/13	Forests	Text: Chapter 6 Reserve reading: Our Forest Bounty, pp. 2-19.
5/15	Wildlife	Text: Chapter 8 Bulletin: "Wildlife an Extra Gift from the Land."
5/22	Conservation of Environment	Text: Chapter 10
5/25	Future Outlook	Text: Chapter 12

APPENDIX D

Detailed Instructional Outline

NATURAL SCIENCE 100

Instructional Outline for Experimental Class

First week:

Part I: The Nature of Biological Science

Feb. 3 Lecture: Introduction to biological science and course objectives

4 Lab sec. A: Use of microscope

5 Lecture: Introduction to the literature and men in biological science

6. Lab sec. B*

7. Lecture: Procedure in science

Second week:

10 Lecture: Limitations of science

11 Lab sec. A: Film, "Characteristics of plants and animals," (10 min.); discussion evaluating lectures to date

Part II: The Nature of Life

12 Lecture: Characteristics of living things

13 Lab sec. B

14 Test over first four lectures

Third week:

17 Lecture: The cell

18 Lab sec. A: The cell and cell division

19 Lecture: Growth (cell division)

20 Lab sec. B

21 Lecture: Sexual and asexual reproduction

Fourth week:

24 Lecture: Genetics

25 Lab sec. A: Films, "Asexual reproduction" (10 min.) and "Basic nature of sexual reproduction" (14 min.)

26 Lecture: How living things are classified

27 Lab sec. B

28 Test over the characteristics of living things, the cell, cell division, reproduction and genetics

Fifth week:

March 2 Lecture: Phylum Protozoa

3 Lab sec. A: Ameba, Paramecium and Hydra

4 Lecture: Phylum Protozoa continued

5 Lab sec. B

6 Lecture: Phylum Porifera and Coelenterata

Sixth week:

9 Lecture: Phyla Platyhelminthes and Nemathelminthes

10 Lab sec. A: Planaria and Ascaris

11 Lecture: Phylum Annelida

12 Lab sec. B

13 Test over classification of living things and first six phyla

Seventh week:

16 Film: "Rival World" (27 min.)

17 Lab sec. A: Earthworm and grasshopper

18 Lecture: Phylum Arthropoda

19 Lab sec. B

Eighth week:

March 30 Lecture: Phyla Mollusca and Echinodermata

31 Lab sec. A: Two-period lecture on Evolution

April 1 Lecture: Phylum Chordata

2 Lab sec. B

3 Test over last four phyla and evolution

Ninth week:

6 Lecture: Photosynthesis and primary production

7 Lab sec. A: Algae and fungi

8 Lecture: Algae

9 Lab sec. B

10 Lecture: Fungi and bacteria

Tenth week:

13 Lecture: Mosses

14 Lab sec. A: Mosses and ferns

15 Lecture: Ferns

16 Lab sec. B

17 Lecture: Seed-bearing plants; film, "Plant life at work" (10 min.)

Eleventh week:

20 Test over plant unit

Part III: Perpetuation of Life and Resources

21 Lab sec. A: Film, "Population explosion" (45 min.), and discussion of the four handout sheets on population and world land use

April 22 Lecture: The population resource problem

23 Lab sec. B

24 Lecture: Nature of resources (illustrated with slides)

Twelfth week:

27 Lecture: Introduction to ecology

28 Lab sec. A: Film, "Tropical rain forest" (16 min.) and film strip on nature's cycles

29 Lecture: Biotic regions of North America

30 Lab sec. B

May 1 Lecture: Soils

Thirteenth week:

4 Lecture: Soils, by visiting expert, Dr. H. Foth

5 Lab sec. A: Study of three soil monoliths; podzol, gray-brown podzolic, prairie soil

6 Lecture: Film, "Water famine" (54 min.)

7 Lab sec. B

8 Test over population, ecology, biotic regions and soils

Fourteenth week:

11 Lecture: Water

12 Lab sec. A: Film, "The River Grand" (29 min.) and discussion of water pollution

13 Lecture: Forests

14 Lab sec. B

15 Lecture: Wildlife

Fifteenth week:

May 18 Film, "Wildlife and the human touch" (19 min.) and briefing on all day field trip to Kellogg Bird Sanctuary and Kellogg Forest area

19 Combine labs A and B for all day field trip

20 Lecutre: Conservation of environment

22 Post-testing of attitude test

Sixteenth week:

25 Lecture: "Where do we go from here?"

26 - 29 Final exams: General test over resource unit

*Lab sec. "B" always covers the same material as "A"

APPENDIX E

The Lecture Outlines

NATURAL SCIENCE 100
The Population, Food and Resource Problems

I. History of the human world population growth.

A. Growth was very rapid during the past 2000 years.

1. Estimated population at time of Christ's birth was 200-300 million.

2. Estimated population by middle of 17th century A.D. was 500 million.

3. Estimated population by 1850 A.D. was one billion.

4. Population by 1960 A.D. was three billion.

5. Estimated population by 2000 A.D. is six plus billion.

(From U.N. report, Population and Food Supply, 1962)

II. Early population studies made by Thomas Malthus of England, published in 1798 in his book entitled An Essay on the Principle of Population as it Affects the Future Improvement of Society.

A. Claimed population is necessarily limited by means of subsistence.

B. Population increases where the means of subsistence increase, unless prevented by powerful checks.

C. Population tends to increase at a geometric rate. (1, 2, 4, 8, 16 etc.)

D. Food supply can usually be increased at an arithmetic rate. (1, 2, 3, 4, 5 etc.)

E. Population tends to outstrip its means of subsistence, which was occuring in Europe during his time.

III. 19th century brought a sudden change in food production and Malthus was forgotten.

A. Factors which caused increase in food production.

1. Chemical fertilizers were discovered and used.

2. There was an increase in acreage after abandonment of long used 3-field system - 1/3 of the land lay idle each year.

Population, con't. 2

3. Research started in England on farming methods.

4. Increase in quantity of livestock produced more manure.

5. Increase in bread grain came with the opening of the black earth area of Europe.

6. Preservation methods were improved.

7. Transportation was improved.

IV. Revival of Malthusian theory as the world population again overtakes the food supply.

A. Population growth is no longer an undulating pattern of gains and losses, but is now a steady upward trend.

B. Natural checks have been temporarily removed.

1. Modern medicine is controlling disease.

2. Sanitation habits are better.

V. Problems created by the increase in population.

A. Malnutrition

B. Housing shortage

C. Moral problems

D. Political problems

E. Pressure upon resources

F. Space - population density of Puerto Rico is now 600 per square mile.

VI. Food problem is facing the world.

A. 2/3 of the world is undernourished - getting less than 2500 calories a day.

1. Number of underfed approximates 98% in Asia, 93% in Africa, 80% in South America and 44% in Europe.

Population, con't. 3

2. Food production has increased in most countries but population is increasing faster.

3. Calories alone do not measure nutritional needs; proteins, minerals and vitamins are also required.

VII. Natural resources are a problem.

A. Natural resources are being consumed at a faster rate.

1. There will be less goods per consumer.

2. United States should examine its ever-expanding business theory.

B. Underdeveloped nations are now desiring a higher standard of living.

1. They are becoming resource conscious.

2. They will resist exploitation by other nations.

VIII. There are two possibilities for population stabilization.

A. Planned parenthood is a possibility.

B. Natural checks such as stress, starvation, disease and war will control population if man doesn't.

Bibliography

Deevey, E. S. The Human Population. Scientific American, September, 1960.

Hainsworth, Reginald G. A Graphic Summary of World Agriculture. Washington, U. S. Dept. of Agriculture, 1949.

Malthus, Thomas, Julian Huxley and Frederick Osborn. On Population: Three Essays. New York, The New American

Cook, Robert. Population and Food Supply. United Nations, 1962.

NATURAL SCIENCE 100

The Nature of Resources

Part I

Definition of terms (ten minutes)

1. Resource
2. Renewable resources
3. Nonrenewable resources
4. Conservation

Part II

Resources Identified

Illustrated lecture using fifty-eight kodochrome transparencies (forty minutes). The lecture to be divided into the following eight areas:

Topic	No. of Slides
1. Introduction	3
2. Soil	12
3. Water	4
4. Forests	8
5. Wildlife	20
6. Grasslands	1
7. Minerals	1
8. Recreation	9

NATURAL SCIENCE 100

Introduction to Ecology

I. Ecology defined: The study of the interrelationships of organisms to one another and to the environment.

   A. No organism ever exists in a vacuum.

   B. Every living thing is influenced by and influences its surroundings.

II. Ecological concepts defined.

   A. Biotic community is an assemblage of species of plants and animals inhabiting a common area.

   B. Ecosystem is a combination of a biotic community with its physical environments.

      1. Ultimate source of energy is sunlight.

      2. Only green plants can synthesize foodstuffs by use of sunlight energy.

   C. Biogeochemical cycles is the circulation of essential elements of protoplasm from environment to organisms and back to the environment.

      1. Two examples are the nitrogen cycle and the carbon cycle.

      2. Another example is the hydrologic cycle.

   D. Energy is transferred.

      1. There is a flow of energy through the food chain.

      2. No transfer of energy if 100% efficient; e.g., the second law of thermodynamics states that in any transfer of energy from one form to another, some energy is always lost.

      3. Energy may be lost in reflected light, heat or respiration.

      4. Plants may utilize only 1% of available light.

Ecology, con't. 2

E. Food chain is a figure of speech for the dependence for food of organisms upon others in a series.

F. Food web is all the interconnecting food chains in a community.

G. Biotic succession is the progressive changes in vegetation and in animal life which may culminate in the climax.

1. Changes are orderly and progressive.

2. Some changes are due to competition.

3. Some changes are due to influence that organisms have upon their environment.

H. Pioneer community is a group of plants that are able to colonize and inhabit a bare surface; e.g., lichens growing on rock.

I. Climax community is the end product in any succession.

1. It is a relative stable community.

2. It is last and permanent.

3. It contains few number of species.

4. Inflow and use of nutrients is stablized.

J. There are two categories of succession.

1. The primary takes place in areas that have not previously supported life; e.g., bare rock, sand and exposed alluvium.

2. The secondary occurs where the original vegetation has been destroyed or disturbed.

a. Fire

b. Plowing

c. Flooding

d. Lumbering

e. Grazing

f. Spraying

Ecology, con't. 3

Bibliography

Dasmann, Raymond F. Environmental Conservation. New York, John Wiley & Sons, 1960.

Hanson, Herbert C. Dictionary of Ecology. New York, Philosophical Library, 1962.

Hegner, Robert W. and Karl A. Stiles. College Zoology. New York, Macmillan Co., 1959.

Odum, Eugene P. Fundamentals of Ecology. Philadelphia, W. B. Saunders, 1959.

Oosting, Henry J. The Study of Plant Communities. San Francisco, W. H. Freeman & Co., 1956.

NATURAL SCIENCE 100

The Major Biotic Regions of North America

I. Biotic region defined: A biotic region (biome) is the largest land community unit which is convenient to recognize.

   A. It is produced by regional climates interacting with regional biota and substrate.

   B. It is called "major life zones" in Europe.

   C. Different life zones are encountered as we proceed away from the equator or ascend a mountain.

II. There are five major regions in North America.

   A. The tundra area defined.

      1. It is the treeless arctic region of the far north reaching southward in the higher mountains. (See map on p. 27 in the text.)

         a. Winters are long and summers short.

         b. Precipitation is low, mostly in the form of snow.

         c. It is the region of permafrost.

         d. Soils are waterlogged in summer.

      2. The dominant vegetation is grasses, sedges, lichens and mosses and are of the low growing type.

      3. Animal life found in this area.

         a. Birds are waterfowl, shorebirds, snowy owl and ptarmigan.

         b. Mammals are lemming, arctic fox, wolf, musk ox, barren ground caribou and arctic hare.

         c. Reptiles are absent in this area.

         d. Insects are very abundant during short summers.

Biotic regions, con't. 2

B. The coniferous forest (taiga or boreal forest) defined.

1. The location is from timberline southward in North America into northeastern United States.

a. Winters are bleak and summers cool.

b. Precipitation is moderate.

c. Soil is a podzol, low in fertility and acid.

2. Dominant vegetation is evergreens: e.g., spruce, firs, pines and cedars.

3. Animal life found in this area.

a. Birds are various grouse, warblers, jays and chickadees.

b. Mammals are moose, woodland caribou, deer, elk, black bear, red fox, lynx, pine martin, fisher, wolverine and snowshoe rabbit.

c. Reptile and amphibian species are very few.

C. The deciduous forest defined.

1. The location is farther south in eastern part of North America.

a. Winters are cold and summers warm.

b. Precipitation is relatively heavy, 30-40" of annual rainfall.

c. Soil is a gray-brown podsolic in the northern part and red and yellow podsolic in the warmer southern part.

d. An area greatly modified by man.

2. Dominant plants are broad-leaved type such as oak, maple, beech, elm and walnut with many shrubs and herbs also present.

3. Animal life found in this area.

a. Birds are ruffed grouse, bobwhite quail, wild turkey and song birds.

Biotic regions, con't. 3

b. Mammals are white-tailed deer, red and gray fox, skunk, bobcat, racoon and tree squirrels.

c. Snakes and amphibians become more numerous.

D. The grasslands defined.

1. The location is from the Mississippi Valley west to the Rocky Mountains and from Texas into southern Canada.

a. Eastern portion is called the prairies and western portion the Great Plains.

b. Winters are severe continental cold.

c. Summers are hot.

d. There is low rainfall - may be cyclic and erratic.

e. Soil is fertile grassland type.

1) Topsoil is dark and high in organic matter.

2) Minerals are not leached out.

2. Formerly the dominant vegetation was grasses.

a. Tall grasses were found in eastern portion.

b. Mixed, short and bunch grasses were found as proceeded west.

3. Animal life found in this area.

a. Birds are prairie chicken, burrowing owl, hawk and meadow lark.

b. Mammals are bison, pronghorned antelope, coyote, badger, prairie dog, jack rabbit, ground squirrel and mice.

c. A few snakes occur here.

E. The desert defined.

1. The location is southern California to western Texas and southward.

Biotic regions, con't. 4.

a. The soil is sandy or rocky.

b. The temperature is high in summer.

c. The average rainfall is 10" or less.

2. The vegetation is cacti, yuccas, desert scrub and creosote bushes - plants are scattered.

3. Animal life found in this area.

a. Birds are few in number.

b. Mammals are rodents and small carnivores.

c. Reptiles and amphibians are many lizards, some snakes and few amphibians.

d. Arthropods such as spiders and scorpions are quite numerous.

Bibliography

Dasmann, Raymond F. Environmental Conservation. New York, John Wiley & Sons, 1960.

Hunter, G. W. and F. R. Hunter. College Zoology. Philadelphia, W. B. Saunders Co., 1951.

Oduum, Eugene P. Fundamentals of Ecology. Philadelphia, W. B. Saunders Co., 1959.

Storer, Tracy I. and Robert L. Usinger. Elements of Zoology. New York, McGraw-Hill Book Co., 1961.

NATURAL SCIENCE 100

SOIL

I. Characteristics of soil

A. Related to the earth as the rind is related to an orange

B. Deep in some places and shallow in others

C. A link between rocks and living things

D. Consists of minerals, organic matter, water and air

E. Occupies space

F. Has three dimensions (soil body)

G. Has a profile

1. Consists of two or more layers, known as horizons, lying one below the other and parallel to the land surface

2. Called A, B and C horizons (see handout sheet)

a. "A" horizon called surface soil

1) High in organic material

2) Area of abundant life

b. "B" horizon called subsoil

1) Fewer living organisms

2) Area of clay accumulation

c. "C" horizon called parent material

1) May have accumulated in place by the breakdown of rock

2) May have been moved in by water, wind, or ice; e.g., in Michigan, parent material is glacial till brought in 8 - 10,000 years ago

H. Is evolutionary as young soil will mature and grow old with time

Soil, con't. 2

II. Formation of soils

A. Mineral soils

1. Weathering of rock provides soil parent materials

a. Physical factors tending to weaken the rock structure

1) Heating and cooling

2) Freezing and thawing

3) Wetting and drying

b. Chemical factors

1) Made slightly acid by rain absorbing carbon dioxide

2. Adding organic material and nutrients by plants

a. Pioneer plants are simple plants such as lichens

b. Bacteria and fungi possible early invaders

c. Moss and more complex plants following

B. Organic soils (peat and muck)

1. Develop by slow decomposition of plants in marshes and bogs

a. Low in fertility

b. Presents several management problems

III. Formation of horizon

A. Surface layer high in organic matter - horizon "A"

B. Appearance of horizon "B" after "A" becomes distinct

1. Clay lost from the surface layer accumulating in the "B"

2. Leaching and eluviation affecting soils of humid regions

Soils, con't. 3

IV. Five factors influencing soil formation

A. Time

1. Developing of Michigan soils since receding of last glacier

2. Requiring longer time to make soil from freshly exposed limestone

B. Parent material

1. Glacial deposits

2. Rock

3. Loess - windblown silty sediments

C. Topography (lay of the land)

1. Runoff, drainage and erosion affected

2. Flat topography

a. Adds to the soil extra water

b. Produces higher amounts of organic matter in the "A" horizon

c. Reflects gray or mottled color

D. Climate - temperature and rainfall

1. Governs weathering of rocks and decomposition of minerals

2. Influences leaching and eluviation

3. Determines vegetation type

4. Interrelates climate, vegetation and soil

E. Vegetation

1. Determines kind and amount of organic matter

a. Rich dark-colored prairie soils formed by fibrous roots of grass

b. Leaves and twigs on surface formed much less organic matter

Soils, con't. 4

2. Nitrogen taken from air and added to the soil by some plants

3. Leaching reversed by deep-rooted plants

4. Climate and vegetation most important soil forming factors producing zonal soils

V. Great soil groups of North America
(See map for locations on p. 94 in text)

A. Tundra

1. Climate

a. Cold and low rainfall

b. Moisture mostly in form of snow

2. Vegetation

a. Lichens

b. Moss

c. Sedges

d. Flowering plants

3. Soil

a. High in organic material and wet

b. Drainage limited by permafrost

4. Best use - grazing of reindeer for meat

B. Podzol

1. Climate

a. Humid

c. Cool

2. Vegetation - mostly conifers

Soils, con't. 5

3. Soil

a. Acid

b. Low in fertility

4. Best uses

a. Forestry

b. Recreation

c. Short season crops

C. Gray-brown podsolic

1. Climate

a. Humid

b. Temperate

2. Vegetation - deciduous forest

3. Soil

a. Mildly acid

b. Moderate fertility

4. Best use - general farming

D. Red and yellow podsolic

1. Climate

a. Warm

b. Humid

2. Vegetation

a. Deciduous

b. Conifer forests

3. Soil

a. Subject to erosion

b. Nutrients low

c. Responds to proper management

Soils, con't. 6

4. Best uses

a. General farming

b. Forestry

E. Prairie soil (Brunizem)

1. Climate - temperature and rainfall same as gray-brown region

2. Vegetation - tall grasses

3. Soil

a. Very fertile

b. High in organic matter

c. Little leaching

d. Only midly acid

4. Best uses

a. Corn

b. Other cereal grains

F. Chernozem (black soils)

1. Climate - 20-30" of annual rainfall

2. Vegetation - mixed prairie grasses

3. Soil - high in organic matter and mineral nutrients

4. Best uses

a. Wheat

b. Other cereal grains

G. Brown grasslands

1. Climate - arid to semi-arid (10-20" of rainfall)

Soil, con't. 7

2. Vegetation - short grass

3. Soil

a. Fertile

b. Lacking in moisture

4. Best use - controlled livestock grazing

H. Desert

1. Climate

a. Hot

b. Arid (5-10" of rainfall)

2. Vegetation

a. Bunch grass

b. Desert scrub

c. Cacti

3. Soil

a. High in nutrients

b. Low in moisture and organic matter

4. Best use - irrigated crops

VI. Soil conservation

A. Destructive forces

1. Damage from cultivation

a. Loss of soil structure

b. Loss of organic matter

c. Loss of plant nutrients

1) Leaching

2) Crop removal

Soil, con't. 7

2. Overgrazing of our grasslands

3. Deforestation

4. Erosion by the agents of water and wind

a. Water

1) Gully erosion

2) Sheet erosion

b. Wind - chief problem in the cultivation of low rainfall area

B. Combating erosion

1. Contour plowing

2. Strip cropping

3. Terracing

4. Use of diversion channels

5. Crop rotation

6. Cover crops

7. Use of mineral and organic fertilizers

8. Grassed waterways

9. Green manuring

10. Gully control

11. Windbreaks of trees and shrubs

12. Range management

13. Reforestation of steep slopes

C. Benefits of slow erosion

1. Keeps soil young

2. Keeps soil productive

Soils, con't. 9

Bibliography

Cheyney, E. G. and T. Schantz-Hansen. This Is Our Land. St. Paul, Webb Publishing Co., 1946.

Millar, C. E., Wm. Turk, H. D. Foth. Fundamentals of Soil Science. New York, John Wiley & Sons, Inc., 1951.

Smith, Guy-Harold. Conservation of Natural Resources. New York, John Wiley & Sons, Inc. 1950.

Yearbook of Agriculture, 1957. Soil. Washington, U. S. Printing Office, 1957.

Kellogg, Charles E. The Soils That Support Us. New York, The Macmillan Co., 1961.

Soil Conservation as "Intelligent Use"

I. Soil as a Resource

A. Fund resources
exhaustible and none - renewable
examples are coal, oil etc.
intelligent use relevantly centers on "saving" and substitution policies

B. Flow resources
inexhaustible and renewable
examples are N in air, Mg in sea, water power
intelligent use centers on maximum use consistent with social, economic and political policies.

C. Biological resources
exhaustible and renewable
examples are forests, wildlife
intelligent use centers on Management to provide "optimum" supply.

D. Soil resources
in a sense, combination of all 3 categories
Fund like - muck soil lost by oxidation
- shallow soil over bedrock lost by erosion

Flow like - annual soil water and oxygen and the release of nutrients through mineral weathering

Biological like - readily available fertility can be exhausted and easily replaced. Maintain fertility at "desirable" level.

II. Can soil be "destroyed" or does it "wear out" if wisely used?

Soils can be exploited and depleted.
Soils can be cropped and preserved.

		Corn bu/acre			
		1954	1955	1956	1958
1888-1958 -	Continuous corn no fertilizer	33	36	29	31
1888-1954 -	Continuous corn no fertilizer				
1955-1956 -	properly fertilized (Morrow plots Univ. of Illinois)	33	86	113	130

III. Are soil resources sufficient for the 20th century?

Ice and snow	11%
Tundra	4
High Mountains	16
Desert and semi-desert	17
	48%

About 10% of earth's surface is cultivated
About 25% of land in U. S. is crop land

(Lecture given by Dr. Henry Foth, Soils Department, Michigan State University.)

NATURAL SCIENCE 100

Water

I. Necessity of water

A. All life completely dependent upon water

1. Drinking water for man and beast

2. Soil water for vegetation

3. Surface water for aquatic organisms

II. Source of water

A. Surface water

1. Streams and rivers

2. Lakes

3. Reservoirs and tanks

B. Groundwater

1. Is precipitation that soaks into the earth

2. Is stored in and transmitted through the porous rocks below the land surface.

3. Is a reserve that amounts to many times the total volume stored in all the nation's natural and artificial surface reservoirs

III. The hydrologic cycle

A. Circulation of water from the sea to land and back to sea again

1. Precipitation

a. Rain

b. Snow, hail and sleet

2. Evaporation

a. From air, soil and bodies of water

b. From plants (transpiration)
(See figure 61 page 124 in text)

Water, con't. 2

IV. Growing need of water

A. Human consumption increasing rapidly

1. Population increasing

2. Per capita use rising

B. Expanding industry using more water

C. Irrigated land increasing

V. Uses of water

A. Domestic

1. Drinking water and cooking

2. Sanitary purposes, personal cleanliness and laundry

3. Fire protection and air conditioning

B. Industrial

1. An ingredient of the finished product

2. Agent of cooling

3. Diluting and removal of industrial waste

C. Source of power

D. Transportation

E. Recreation e.g., swimming, boating and fishing

VI. Water problems

A. Pollution of lakes and streams

1. Sewage

a. Spreads disease e.g., cholera, typhoid fever, hepatitis

b. Is an oxygen - demanding waste

2. Industrial wastes

Water, con't. 3

3. Siltation
4. Radioactive substances
5. Synthetic detergents
6. Pesticides and insecticides
7. Heat
8. Acid drainage from coal mines

B. Declining watertable

1. Is believed by many that groundwater is being removed faster than it can be replaced by precipitation
2. A real need for long range research on this subject

C. Flooding

1. Loss of human lives and property damage
2. Destructive to bridges, roads and bury fertile farm lands

VII. Conservation measures

A. Watershed management

1. Planting of trees and grasses
2. Controlled logging and grazing
3. Contour plowing and strip croping on hills
4. Crop residues and mulching

B. Multipurpose dam

1. Source of drinking water
2. Recreation and transportation
3. Power
4. Irrigation water

Water, con't. 4

C. Redistribution of water

D. Making salt water fresh

E. Reuse of water

F. Discontinue dumping raw sewage, organic and industrial wastes into streams

1. Need for more sewage treatment works and improvement of existing facilities

2. Construction of waste treatment plants by industry

Bibliography

Cahart, Arthur H. Water Or Your Life. Philadelphia, J. B. Lippincott Co., 1951.

Callison, Charles H. America's Natural Resources. New York, The Ronald Press Co., 1957.

Clean Water. Public Health Service Publication No. 11. Washington, D. C., Superintendent of Documents, 1950.

Ellison, W. D. "Erosion by Raindrop." Scientific American, November, 1948.

Highsmith, Richard M., Jr., Granville J. Jenson, Robert D. Rudd. Conservation in the United States. Chicago, Rand McNally & Co., 1962.

Sayre, A. N. "Groundwater." Scientific American, November, 1950.

"The Struggle for Clean Water." Public Health Service Publication No. 958. Washington, D. C., Superintendent of Documents, 1962.

"Water for Farm and City." U. S. Department of Agriculture, Washington, D. C., Superintendent of Documents, 1960.

Waters of Coweeta, U. S. Department of Agriculture, Washington, D. C., Forest Service, 1953.

NATURAL SCIENCE 100

Forest

I. History of forestry in U. S.

A. Logging first in Maine

B. The Pennsylvania forest

C. The lake states stand of pine

D. Southeastern pine forest

E. The Pacific Northwest

1. Oregon the number one lumber producer today

2. State of Washington now second in production

II. Five natural forest regions in the U. S.

A. Three east of the prairies

1. Northern forest

a. Produces mostly softwoods such as pines, tamarack, spruce, hemlock, firs and cedars

b. Some intermingled mixed stands of hardwoods

2. Central hardwoods

3. Southern forest

a. Produces shortleaf, longleaf, loblolly and slash pine on high lands

b. Produces some lowland species such as cypress, red and black gums also

B. Two western areas

1. The Rocky Mountain

2. The Pacific Coast

III. Ownership of forests

A. Private

1. Lumbering concerns

2. Farm woodlot

Forest, con't. 2

B. Community

C. State

D. National (See handout pertaining to State and National forests in Michigan)

IV. Products of the forest

A. Unprocessed timber

1. Lumber

2. Fuelwood

3. Posts, poles and pilings

4. Veneer and plywood

5. Railroad ties

6. Cooperage (for barrels)

7. Excelsior, shingles and sporting goods

B. Wood conversion products

1. Pulp and paper

2. Rayon and plastic

3. Distillation (turpentine, resin, acetic acid and wood alcohol)

C. Secondary products

1. Cork

2. Christmas trees

3. Resin, dyes and tannin

4. Fruit and sugar

V. Multiple use concept

A. Forest need not be grown for trees alone

Forest, con't. 3

1. Aesthetic and recreational value
2. Provide homes for wildlife
3. Protect soil from erosion
4. Regulate stream flow
5. Serve as a windbreak
6. Controlled livestock grazing

VI. Tree crops for food

A. The proper plant for hill country

1. Maple syrup, nuts and fruits for man
2. Acorns and chestnuts for livestock

B. These trees important to man in pioneer times

C. A possible future means of supplementing our food supply

VII. Forest conservation

A. First conservation emphasis in forestry

B. Two approaches to forest conservation

1. Protection

a. Fire
b. Insects
c. Disease
d. Grazing livestock

2. Management

a. Proper cutting practices
b. Selective cutting
c. Sustained yield
d. Efficient milling
e. Utilization of wastes

Forest, con't. 4

Bibliography:

Allen, Shirley Walter, An Introduction to American Forestry. New York, McGraw-Hill Book Co., 1950.

Carhart, Arthur H. The National Forests. New York, Alfred A. Knopf, 1959.

Cheyney, E. G., Hansen T. Schantz. This Is Our Land. Saint Paul, The Webb Publishing Co., 1950.

Schery, Robert W. Plants for Man. Englewood Cliffs, Prentice-Hall, 1956.

Smith, Guy Harold. Conservation of Natural Resources. New York, John Wiley and Sons, 1950.

Stoddard, Charles H. Essentials of Forestry Practice. New York, The Ronald Press Co., 1959.

Worrell, Albert C. Economics of American Forestry. New York, John Wiley & Sons, 1959.

FISH AND WILDLIFE

I. Wildlife another part of the composite of resources

A. Our nation possesses an abundance and variety of environments

1. Marshes, costal and inland waters

2. Forests, farms, grasslands and alpine meadows

3. Each supports its own community of wildlife forming a particular ecosystem

II. Values of wildlife to man

A. Recreation

1. Hunting for sport

2. Photography

3. Watching and studying

4. Aesthetic value

a. Wildlife today plays only a small role in the material economy

b. Is increasingly significant in the enrichment of living

1) Man living in an artificial environment

2) Is harassed by many pressures and tensions

3) Increase in leisure time

B. Food and fur

C. Biological value

III. Present wildlife resources

A. Farm wildlife

B. Forest and Range

C. Wilderness

Fish and Wildlife, con't. 2

D. Migratory

E. Resident aquatic
(See handout sheet for checklist)

IV. Some basic problems in wildlife management

A. Ownership

B. Hunting pressure

C. Land use

D. Public apathy

E. Public ignorance

1. Insistance upon predator control and bounty system

2. Insistance upon introduction of new species

F. Alteration of the environment by man

1. Pollution of waters

2. Drainage of swamplands

3. Clearing the forests

4. Development of grasslands for agricultural purposes

5. Use of sprays

6. Faulty farm practices causing a decline in productivity of the land

V. Some basic problems in fish management

A. Dams block the migration routes

B. Pollution

C. Deforestation

1. Siltation

2. Loss of forest sponge

3. Warming of trout waters

Fish and wildlife, con't. 3

E. Water diversion

F. Increased fishing pressure (trout affected most)

VI. Management of wildlife

A. Built upon three basic concepts

1. Soil, water, forest and wildlife conservation all parts of one inseparable program

2. Wildlife requires environment suited to its needs

3. Any use made of any living resource must be limited to no more than the annual increase

B. Wildlife a by-product of land use

C. Is a renewable resource which is subject to management by man

D. Basic requirements food, water, cover and suitable climate

VII. History of wildlife management

A. First set hunting season

B. Set bag limit

C. Market hunting outlawed

D. Establishment of refuges

E. Predator control

F. Artificial propagation

G. Introduction of exotic species

H. Habitat improvement (ecological approach)

VIII. Vanished and vanishing species

A. Extinction is nothing new

B. Speeded up by acts of man (See handout)

IX. Agencies and organizations interested in wildlife problems

A. State Dept. of Conservation

Fish and wildlife, con't. 4

B. Many universities and colleges

C. The United States Fish and Wildlife Service

D. National Parks Service

E. U. S. Forest Service

F. U. S. Soil Conservation Service

G. Private organizations, e.g. National Audubon Society, American Wildlife Federation and The Izaak Walton League of America

1. Act as the watchdog of government activities

2. Education of the public

Bibliography

Callison, Charles H. American Natural Resources. New York, The Ronald Press Co., 1957.

Highsmith, Richard M., Jr. et al. Conservation in the United States. Chicago, Rand McNally & Co., 1962.

Hill, R. G. and Bradt G. W. Producing Wildlife by Good Farm Use. East Lansing, Michigan State University, 1948.

Leopold, Aldo. Game Management. New York, Charles Scribner's Sons, 1937.

Olaus, Mario, Can Animals Survive in a Fast-Changing World? Audubon, Nov.-Dec., 1963. p. 359.

Smith, Guy-Harold. Conservation of Natural Resources. New York, John Wiley & Sons, 1950.

"Big Game Inventory, 1958," Wildlife Leaflet 411. Washington, Fish and Wildlife Service, 1959.

Game Management on the Farm. Farmers bulletin No. 1759. U. S. Dept. of Agriculture, Washington, D. C., 1936.

Distribution of American Gallinaceous Game Birds. Circular 34. Washington, Fish and Wildlife Service, U.S. Dept. of Interior, '55.

Duck Stamps and Wildlife Refuges. Circular 37. Washington, Fish and Wildlife Service, U.S. Dept. of Interior, 1955.

Michigan Wildlife Sketches (Mammals). Lansing, Michigan Dept. of Conservation, 1950.

CONSERVATION OF ENVIRONMENT

I. Why a concern

A. National population expected to more than double in the next half century

1. Result in reduction of space for wildlife, man and his crops

2. More pollution of water and air

3. More hunters and fishermen

4. More demand for recreation

B. Destruction by the bulldozer, chainsaw and foilage sprays

C. Present philosophy is to turn all resources into wealth

II. Need of environment for recreation

A. Natural areas (undisturbed) e.g., wooded ravine, pond, marsh, creek or idle unproductive land

1. The outdoor lab for school study and instruction

a. Owned by school system

b. Owned by local government

2. For family enjoyment

a. Nature walks

b. Exploring for relaxation and inspiration

c. Collecting and study of native flora and fauna

B. Wilderness areas

1. Is a very large tract of land

2. Should be maintained in primitive condition

3. Multiple use in function

a. Preservation of wilderness plants and animals

Conservation of environment, 2

b. Isolation for those that desire it

c. Study and research

d. Hunting and fishing

C. General recreation areas

D. Camp sites

E. Picnic sites

F. Playgrounds

G. Formal parks

H. Public access to waters for fishing, boating and swimming

III. Environment for food production and raw materials

A. Distruction of crop lands by urban sprawl

1. Homes and lawns

2. Shopping centers

3. Schools

4. Industrial parks

B. Transportation

1. Freeways

a. Now require 166 ft. of space

b. Consuming 20 acres of land per mile

2. Enlargement and construction of new airports

IV. Need for planned land use

A. Leaving of good agriculture land in its present use

B. Use hilly ground, stream side and barren waste areas for construction sites

Conservation of environment, 3

V. Need for quick action

A. This generation must identify and preserve these areas

B. Education of public to the problem

C. United action by interested organizations

D. Acquisition by federal, state and local governments

Bibliography

The Following in AMERICAN BIOLOGY TEACHER, January, 1962.

Galbreath, J. W. "The Value of a Nature Area in Teaching Biology and Conservation," pp. 21-25.

Klotz, John W. "Natural Areas as a Community Resource", pp. 18-20.

Drake, William. "Natural Areas," pp. 14-17.

The following in OUTDOOR RECREATION RESOURCES REVIEW COMMISSION, U. S. Government Printing Office

"Outdoor Recreation for America,"Study Report, 1962.

"Wilderness and Recreation - A Report on Resources, Values and Problems," Study Report 3, 1962.

Shanklin, John,"Multiple Use of Land and Water Areas," Study Report 17, 1962.

Whyte, William H., "Open Space Action," Study Report 15, 1962.

NATURAL SCIENCE 100

Where Do We Go From Here?

I. Development of a sense of public responsibility

II. Research and continued improvement of the productive capacities of our renewable resources

III. Consideration of the total environment

IV. Management of wildlife with the total public in view

V. Close control of the nonrenewable resources

VI. Continue search for new resources

VII. Development and use of substitutes

VIII. Maximum use and minimum waste

IX. Multiple use of resources

X. Inventory as to the quantity and quality of resources available

XI. Projection of resource needs for an increasing population

XII. Planned use of resources

XIII. Cooperation between private, state and federal interests

APPENDIX F

Prepared Handout Materials

NATURAL SCIENCE 100

Publications in College Library Pertaining to Biology and Conservation

Journals and Periodicals

American Forests. American Forestry Association
Audubon. National Audubon Society
Bioscience. American Institute of Biological Science
Ecology. Ecological Society of America
Journal of Mammalogy. American Society of Mammalogists
Journal of Soil & Water Conservation. Soil Conservation Society of America
Living Wilderness. The Wilderness Society
Michigan Conservation. Michigan Dept. of Conservation
Natural History. American Museum of Natural History
Science. American Ass'n. for the Advancement of Science
Scientific American. Scientific American, Inc.
The American Biology Teacher. National Ass'n. of Biology Teachers
The Quarterly Review of Biology. American Institute of Biological Sciences
Today's Health. The American Medical Association
Wisconsin Conservation. Wisconsin Dept. of Conservation

Dewey Numbers of Books

333 Conservation
574 Ecology
575 Heredity and Evolution
580 Plant Life
590 Animal Life
611 Anatomy
612 Physiology
630 Soil and Crop Plants
634 Forests

Selected Books in the Spring Arbor College Library on Renewable Resources:

Allen, Durward L. Michigan Fox Squirrel Management.

Allen, Durward L. Our Wildlife Legacy.

Allen, Shirley Walter. An Introduction to American Forestry.

Allen, Shirley Walter. Conserving Natural Resources

Bear, Ferman E. Chemistry of the Soil.

Bear, Ferman E. Earth the Stuff of Life.

Bennett, Hugh H. Elements of Soil Conservation.

Black, John D. Biological Conservation.

Burt, William H. Mammals of the Great Lakes Region.

Callison, Charles H. American Natural Resources.

Carhart, Arthur H. The National Forests.

Carhart, Arthur H. Timber In Your Life.

Carhart, Arthur H. Water Or Your Life.

Carson, Rachel. Silent Springs

Cheyney, E.G. and T. Schantz-Hansen. This Is Our Land.

Coker, Robert Ervin. Streams, Lakes, Ponds.

Gabrielson, Ira N. Wildlife Conservation.

Golze, Alfred R. Reclamation In The United States.

Graves, Henry S. and Cedric H. Guise. Forest Education.

Gustafson, A.F. et al. Conservation in the United States.

Hanaburgh, David H. Your Future in Forestry.

Harlan, J.R. and Everett Speaker. Iowa Fish and Fishing.

Hornaday, W.T. Wildlife Conservation in Theory and Practice.

Hubbs, C.L. and Karl Lagler. Fishes of the Great Lakes Region.

Huberty, Martin R. and Warren Flock. Natural Resources.

Jarrett, Henry. Perspectives on Conservation.

Kellogg, Charles E. The Soils that Support Us.

Kohnke, Helmut and Anson Bertrand. Soil Conservation.

Kortright, Francis H. The Ducks, Geese and Swans of North America.

La Gorce, John Oliver. The Book of Fishes. (2v.)

Lagler, Karl F. Ichthyology.

La Monte, Francesca. North American Game Fishes.

Leopold, Aldo. Game Management.

McAtee, W. L. The Ring-Necked Pheasant.

McCormick, Jack. The Living Forest.

McNall, P. E. Our Natural Resources.

Millar, C. E. et al. Fundamentals of Soil Science.

Pirnie, M. D. Michigan Waterfowl Management.

Smith, Guy-Harold. Conservation of Natural Resources.

Stoddard, Charles H. Essentials of Forestry Practice.

Stamp, L. Dudley. Land for Tomorrow.

Trippensee, Reuben Edwin. Wildlife Management.

Veatch, J. O. Soils and Land of Michigan.

Weaver, Richard L. Handbook for Teaching of Conservation and Resource Use.

Whitaker, J. R. and Edward Ackerman. American Resources.

Wood, Norman A. The Birds of Michigan.

Worrell, Albert C. Economics of American Forestry.

Yearbook of Agriculture, 1941. Climate and Man.

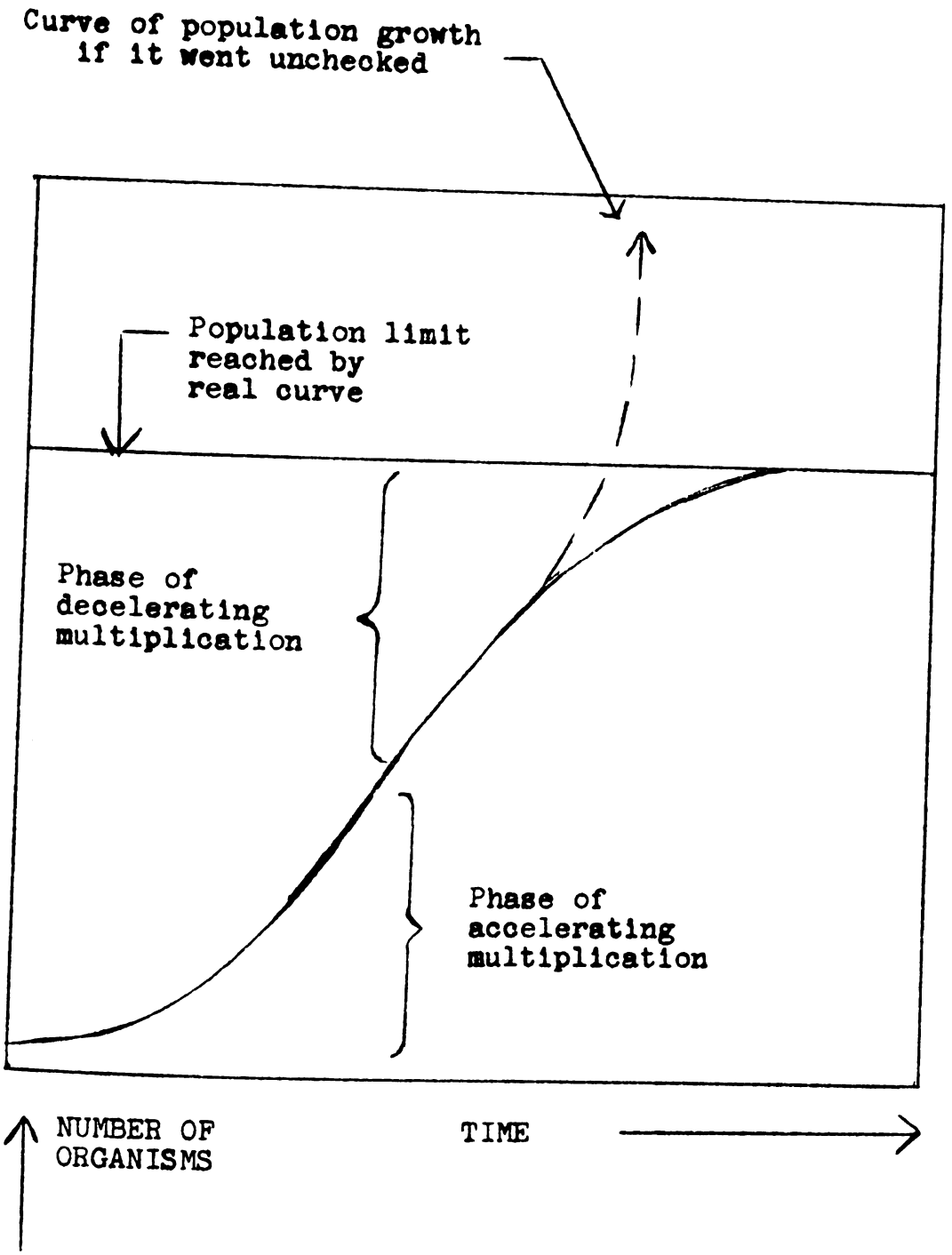
Yearbook of Agriculture, 1949. Trees.

Yearbook of Agriculture, 1955. Water.

Yearbook of Agriculture, 1957. Soil.

Yearbook of Agriculture, 1958. Land.

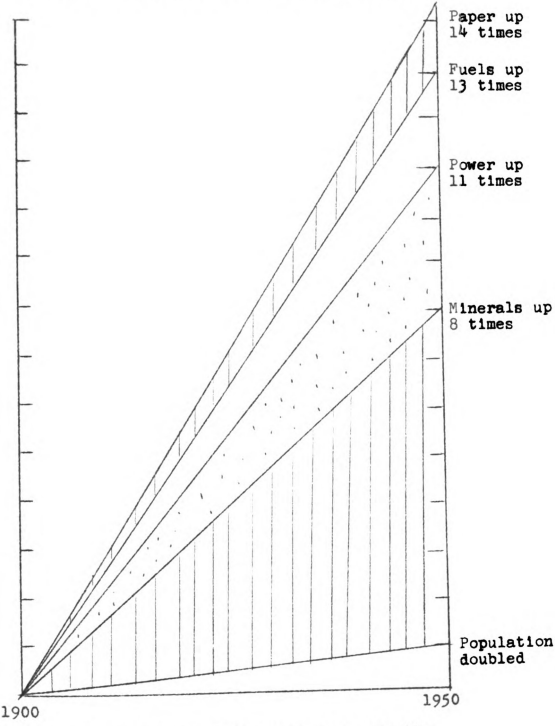
Yearbook of Agriculture, 1963. A Place to Live.



The solid line represents the actual growth of a population; the broken line represents the potential growth.

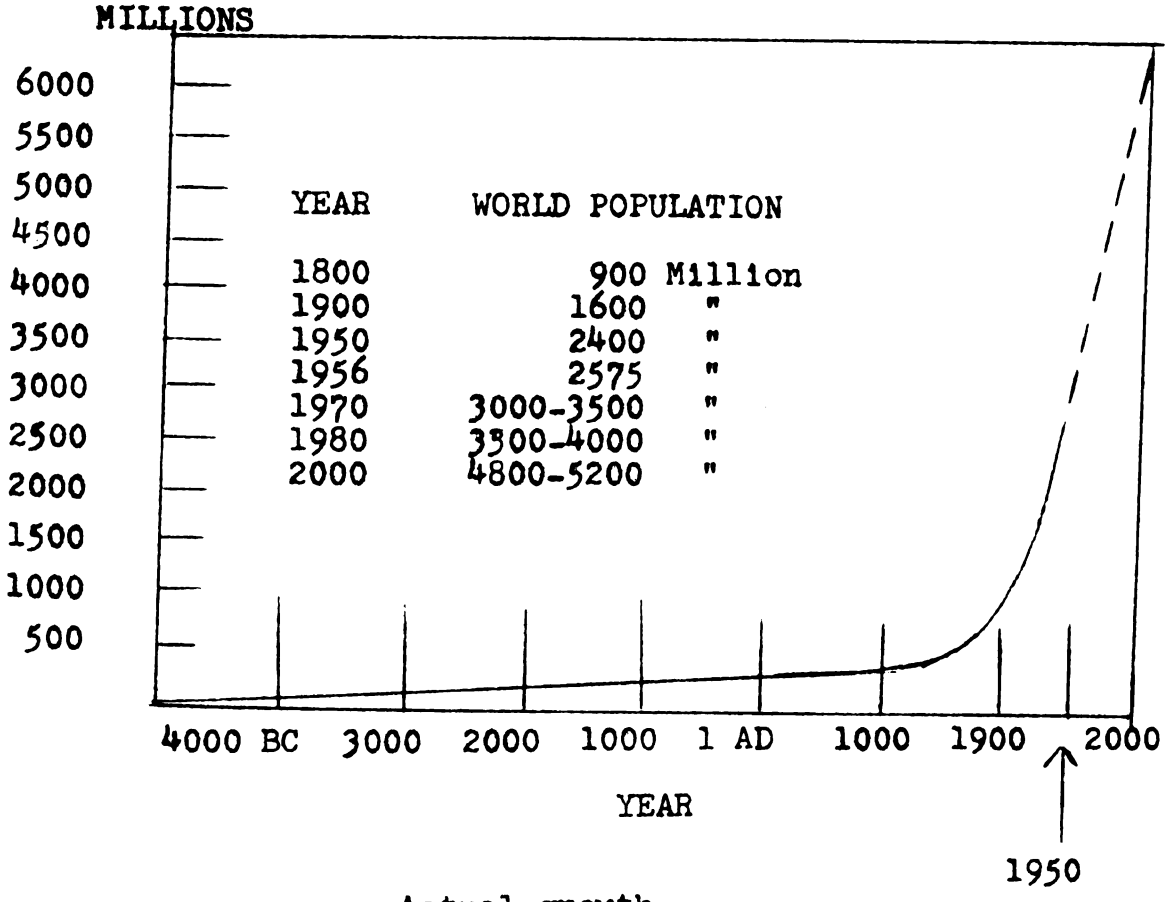
Source: Muller, Walter H. Botany, A Functional Approach, p. 416.

INCREASE IN U. S. POPULATION AND IN USE OF VARIOUS RAW MATERIALS AND RESOURCES, 1900-1950



Source: Ordway, Samuel H. Resources and the American Dream. P. 12.

WORLD POPULATION GROWTH
5000 BC - 2000 AD



———— Actual growth

- - - - - - - - Projected growth from 1956-2000 AD on basis of 1950 growth rates

Source: Muller, Walter H. Botany, A Functional Approach. p. 418.

ECOLOGICAL BOOKS AVAILABLE IN THE COLLEGE LIBRARY

Allee, et al. Principles of Animal Ecology.

Benton, H. A. Principles of Field Biology and Ecology.

Clark G. L. Elements of Ecology

Coker, R. E. Streams, Lakes, Ponds.

Daubenmire, R. F. Plants and Environment.

Dice, L. R. Natural Communities.

Farb, P. Living Earth.

Hanson, H. C. Dictionary of Ecology.

Hesse, R. et al. Ecological Animal Geography.

Hickman, C. P. Field Manual of Animal Ecology and Natural History.

Leach, William. Plant Ecology.

Lemon,P. Field and Laboratory Guide for Ecology.

Leopold, Aldo. Game Management.

Life Nature Library. The Forest.

Mayfield, H. The Kirtland's Warbler.

Moorel, H. B. Marine Ecology.

Oduum, E. Fundamentals of Ecology.

Oosting, H. J. The Study of Plant Communities.

Shelford, V. E. The Ecology of North America

Storer, J. H. The Web of Life.

Tryon, C. A. Ecology of Algae.

Wallace, B. and Dobzhansky, T. Radiation, Genes and Man.

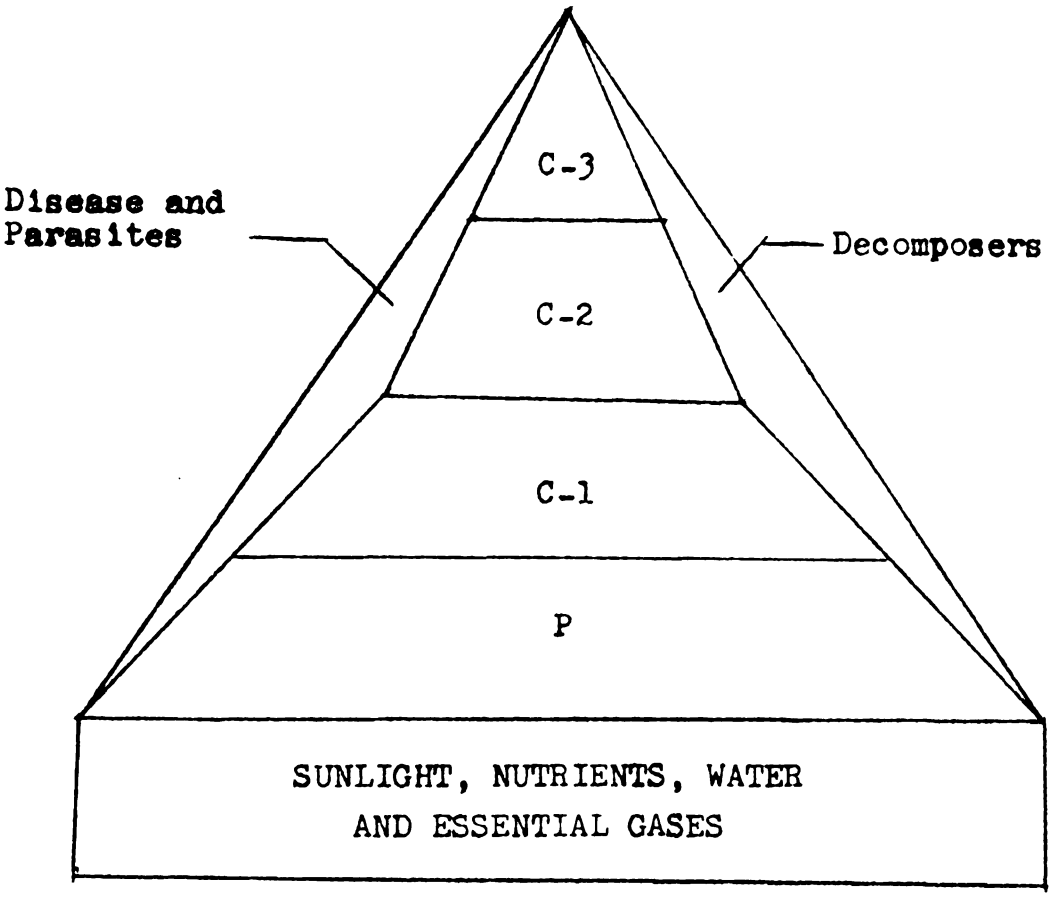
Weaver, J. E. North American Prairie.

Woodbury, A. M. Principles of General Ecology.

Yearbook of Agriculture, 1941. Climate and Man.

Yearbook of Agriculture, 1957. Soil.

A BIOTIC PYRAMID



P Producer organisms - Green plants
C-1 Primary consumers - Herbivores
C-2 Secondary consumers- Carnivores
C-3 Tertiary consumers - Larger carnivores

Decomposers are bacteria and fungi of decay.

Due to inefficiency in energy transfer, numbers, mass and energy decrease as we move up the pyramid.

Example of a simple food chain:

Vegetation - lemming - Arctic fox

Example of a simple food web

Vegetation - lemming - Arctic fox

Vegetation - Arctic hare - Arctic wolf

A GLOSSARY OF TERMS USED IN THE SOILS STUDY

Acid Soil: A soil giving an acid reaction (below $_{p}H$ 7.0).

Alkaline Soil: Any soil that is alkaline in reaction, that is, above $_{p}H$ 7.0.

Bog Soils: An intrazonal group of soils with a muck or peaty surface soil underlain by peat; developed under swamp or marsh types of vegetation, mostly in a humid or sub-humid climate.

Clay: The small mineral soil grains or particles, less than 0.002 mm. in diameter.

Erosion: The wearing away of the land surface by falling or running water, by wind, or by other natural agents such as gravity.

Gray-Brown Podzolic Soils: A zonal group of soils having a comparatively thin organic covering and organic mineral layers over a grayish brown leached layer which rests upon an illuvial brown horizon; developed under deciduous forest in a temperate moist climate.

Green-Manure Crop: Any crop grown and worked into the soil for the purpose of improving the soil, especially by the addition of organic matter.

Horizon,Soil: A layer of soil approximately parallel to the land surface with more or less well-defined characteristics that have been produced through the operation of soil-building processes. Each layer differs from the one above or below in some characteristic.

Humus: The well-decomposed, more or less stable part of the organic matter of the soil.

Land, Arable: Land which, in its present condition, is physically capable, without further substantial improvement, of producing crops requiring tillage.

Leaching: Removal of materials in solution.

Mineralization: The conversion of an element that is in organic combination to the available form as a result of microbial decomposition.

Mottled: Irregularly marked with spots of different colors.

Glossary, con't. 2

Muck Soil: An organic soil composed of highly decomposed organic material, with a considerable amount of mineral soil material, finely divided and with few fibrous remains of the original plants.

Nutrients, Plant: The elements or groups of elements taken in by the plant, essential to its growth, and used by it in the elaboration of its food and tissue.

Organic Soils: Soils containing organic matter in sufficient quantities to dominate the soil characteristics. Frequently all soils containing 20 per cent or more organic matter by weight are arbitrarily designated as organic soils.

Peat: Unconsolidated soil material consisting primarily of undecomposed or slightly decomposed organic matter accumulated under conditions of excessive moisture.

Podzol Soils: A zonal group of soils having an organic mat and a very thin organic-mineral layer above a gray leached layer which rests upon an illuvial dark brown horizon; developed under the coniferous or mixed forest or under heath vegetation in a temperate to cold moist climate. Iron oxide and alumina, and sometimes organic matter, have been removed from the A and deposited in the B horizon.

Profile, Soil: A vertical cross section of the soil from the surface into the underlying unweathered material.

Sand: Small rock or mineral fragments having diameters ranging from 1 to 0.05 mm.

Silt: Small mineral soil grains the particles of which range in diameter from 0.05 to 0.002 mm. (or 0.02 to 0.002 mm. in the international system.)

Soil: The natural medium for the growth of land plants on the surface of the earth. A natural body on the surface of the earth in which plants grow; composed of organic and mineral materials.

Structure, Soil: The morphological aggregates in which the individual soil particles are arranged.

Subsoil: Roughly, that part of the solum below plow depth.

Glossary, con't. 3

Surface Soil: That part of the upper soil of arable soils commonly stirred by tillage implements.

Texture, Soil: The relative proportion of the various size groups of individual soil grains. The coarseness or fineness of the soil.

Till, Glacial: A deposit of earth, sand, gravel, and boulders transported by glaciers. Till is unstratified.

Water Table: The upper limit of the part of the soil or underlying material wholly saturated with water.

Weathering: The physical and chemical disintegration or decomposition of rocks and minerals under natural conditions.

In the compilation of this glossary extensive use was made of the glossary in "Fundamentals of Soil Science" by C. E. Millar, L. M. Turk and H. S. Foth.

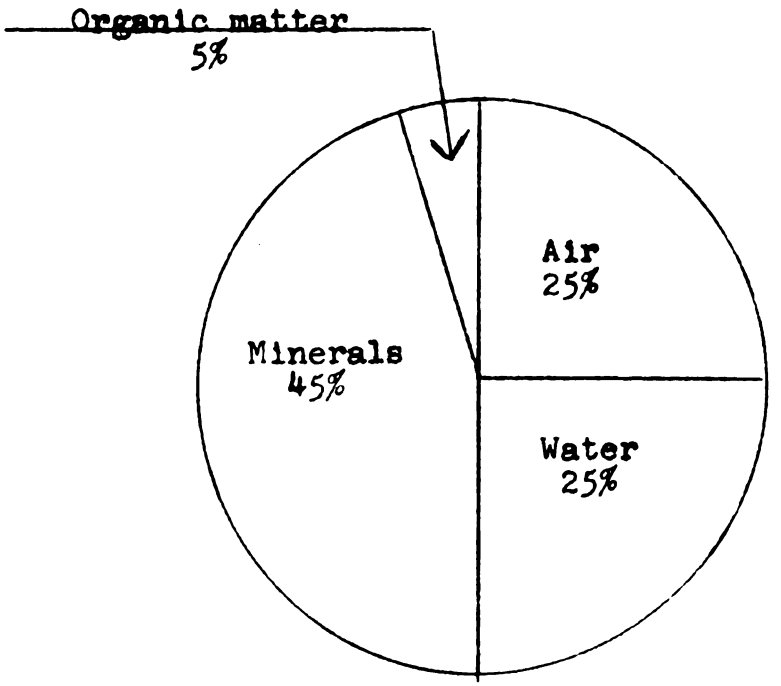
Distribution of cultivated land among the 15 countries having more than 75 per cent of the world's total cultivated land

Country	Acres cultivated	Cultivated land as percentage of total land	Cultivated land per capita	Percentage of world cultivated land
	Thousands	Percent	Acres	Percent
United States	435,000	22.8	3.13	17.6
Soviet Union	414,000	7.9	2.43	16.8
India[1]	382,610	37.9	.98	15.5
China[1]	177,718	13.8	.29	7.2
Argentina	64,395	9.3	4.56	2.6
Canada	63,385	2.9	5.29	2.5
Germany	49,918	42.8	.72	2.0
France	49,338	36.3	1.22	2.0
Poland	47,219	49.2	1.47	1.9
Spain	44,556	35.6	1.65	1.8
Iran	40,795	10.2	2.47	1.6
Manchuria and Jehol	38,386	11.9	.89	1.5
Italy	35,610	47.9	.77	1.4
Australia	34,865	1.7	4.71	1.4
Total	1,877,795			75.8

[1]Twenty-two Provinces (Sikang and Sinkiang not included).

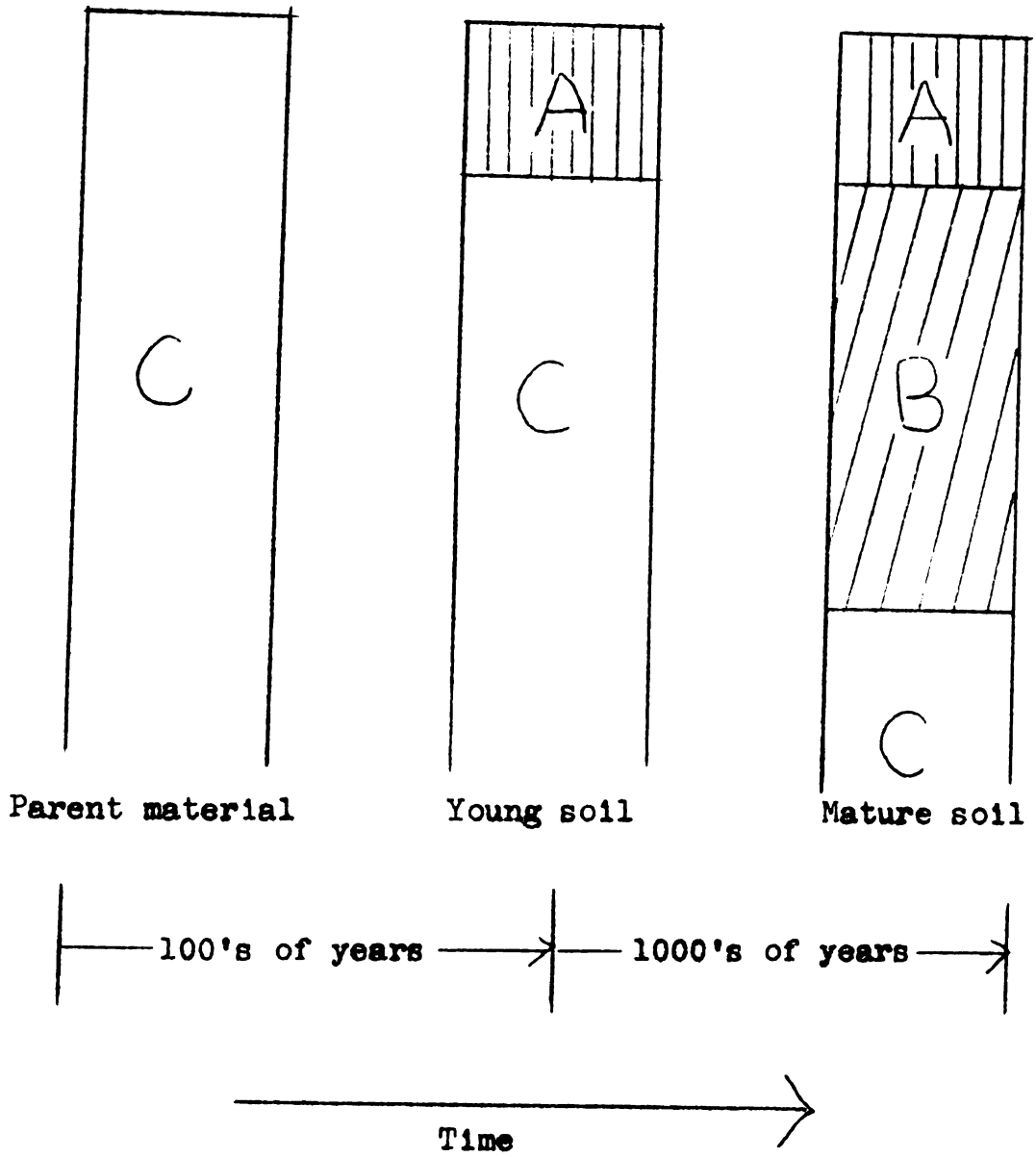
Source: Hainsworth, Reginald G. A Graphic Summary of World Agriculture. Washington, U. S. Department of Agriculture, Office of Foreign Agricultural Relations.

"Ideal" composition of soil by volume
of silt loam textured A1 horizon



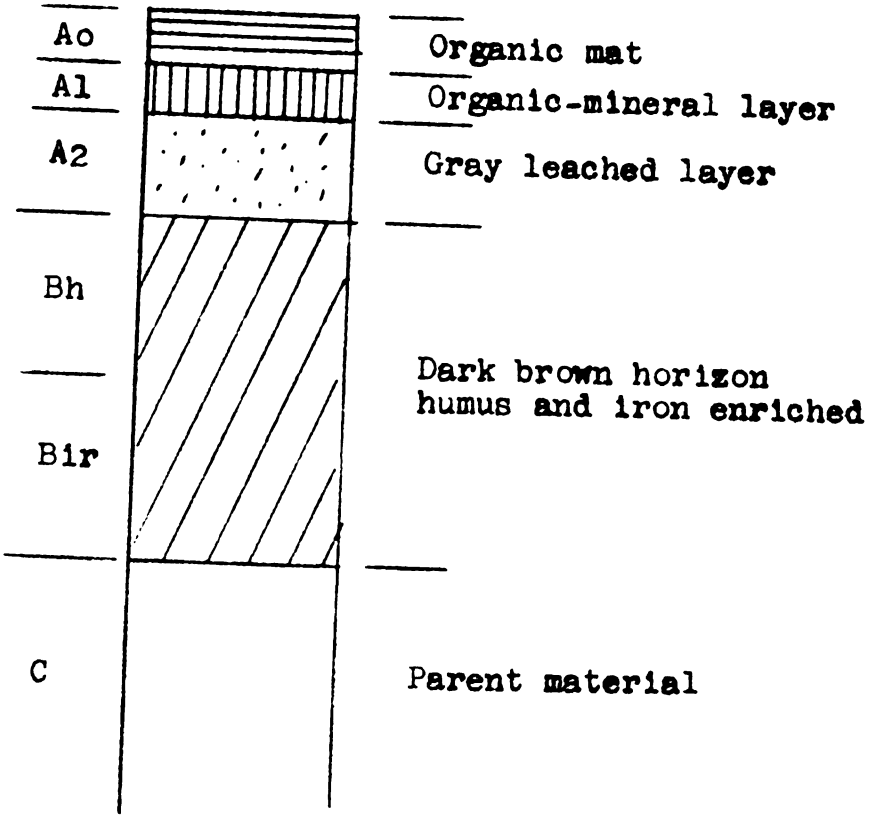
Remarks:

HORIZON FORMATION



Remarks:

PROFILE OF KALKASKA SAND
(A Podzol soil*)



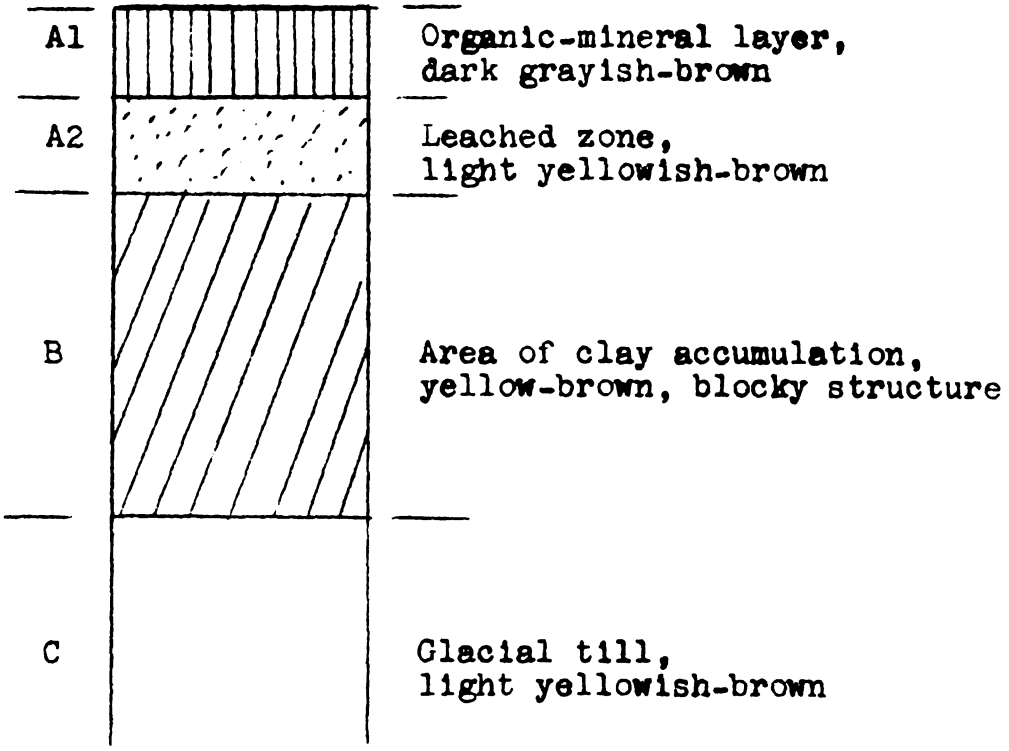
A - Surface soil B - Subsoil C - Parent material

Factors affecting its development

Parent material	- Glacial outwash plains
Topography	- Well drained
Climate	- Cool - humid
Vegetation	- Coniferous or mixed hardwoods
Time	- Period since last glacier (about 8-10,000 years)

*This soil is common in the northern portion of Michigan.

PROFILE OF MIAMI LOAM
(A Gray-Brown Podzolic soil)*



A - Surface soil B - Subsoil C - Parent material

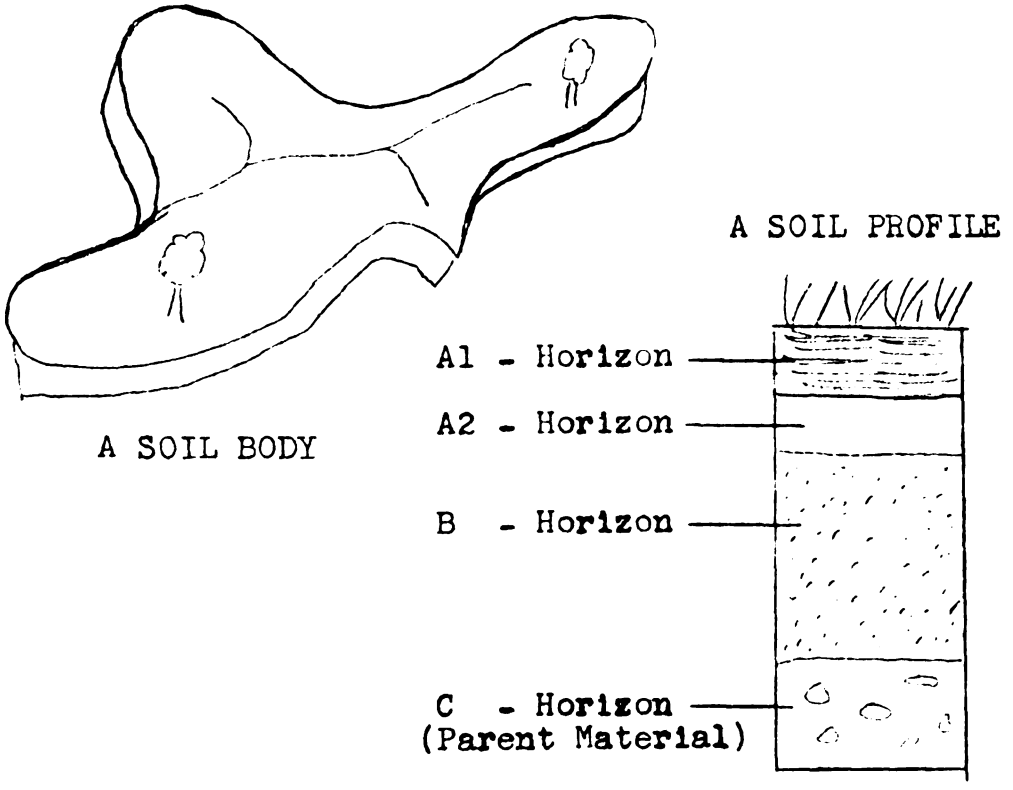
Factors affecting its development

Parent material	- Glacial till of loam texture
Topography	- Well drained
Climate	- Humid-temperate
Vegetation	- Hardwood forest
Time	- Period since last glacier (about 10-20,000 years)

*This soil is common in the lower portion of Michigan on rolling landscape.

AN INTRODUCTION TO THE SOIL AS A NATURAL BODY

The word "soil" in its broad sense, refers to all of the unconsolidated material occupying the earth's surface which provides a natural medium for plant growth. An individual soil, however, is a three-dimensional body with recognizable boundaries. The earth's surface is the soils upper boundary, the depth to which biological activity and weathering occurs approximates the depth to which it extends and laterally it is bounded by other soils which possess different properties. Thus, it can be seen that an individual soil body will occupy a certain definite section of the landscape. A soil profile is a single vertical cross section of a soil body extending from the surface into the underlying parent material. An individual soil body and a soil profile are shown in below figure.



Soils vary from one another in their properties and each has a unique internal organization. Most of the organic matter resulting from the growth of plants is added to the upper layer or horizon of the soil. This horizon is called the A1 horizon and commonly contains more organic matter and is darker in color than the underlying horizons. The soluble and finely divided colloidal materials tend to be carried downward as the water moves through the surface soil, and in forest soils it produces a leached light colored layer called the A2 horizon. The finer materials are not all removed completely from the soil but tend to accumulate further down in the soil profile. The horizon where these finely divided materials (clay, iron, aluminum, organic matter) tend to accumulate is the subsoil; or more specifically, the B horizon. Underlying the B horizon is the C horizon or parent material from which the soil developed.

It should be noted that soils which develop under grass vegetation, such as the Brunizem, Chernozem, Chestnut, and Brown, do not develop an A2 horizon is a major difference in the horizon sequence of soils developed under grass and those developed under forest vegetation.

The significance of this feature of soils, namely, that they are composed of horizons each with different properties, means that a consideration of the entire sequence of horizons is needed in order to develop a program for the efficient utilization of a soil body to produce plants. A seed may be planted and germinate in the surface soil, but the roots of

the plant may extend downward during the growing season and encounter an environment in the lower horizons much different from that of the surface soil in terms of oxygen supply, fertility, moisture, or acidity.

The specific properties and horizon sequence that a soil acquires in the process of its development are determined by the nature of the parent material from which the soil develops and the influence of such environmental factors as topography, climate and vegetation which act over a period of time to transform the parent material into a soil. In various locations where like combinations of parent materials, topography, climate, vegetation and time are found, it is expected that like soils will develop. For instance, the Miami loam soil shown in Figures on page 180 is a soil which results when the soil forming factors are: (1) a loam textured glacial till parent material, (2) a well drained topographical position, (3) a humid and temperate climate, (4) a hardwood forest vegetation, and (5) a period of time which approximates the time elapsed since the melting of the glaciers in the middle and early Wisconsin age. These conditions are fulfilled only in the states of Michigan, Wisconsin, Illinois, Ohio, and Indiana. Hence the Miami loam soil is restricted to these states. If any one of the five soil forming factors had been different, a different soil would have developed.

To make the concept of the soil more meaningful several soil monoliths will be made available for observation and study. (Under certain conditions, it may be advisable to go

to the field and study the soil profile in its natural environment.) As the soil is studied, record information and remarks on the data sheet.

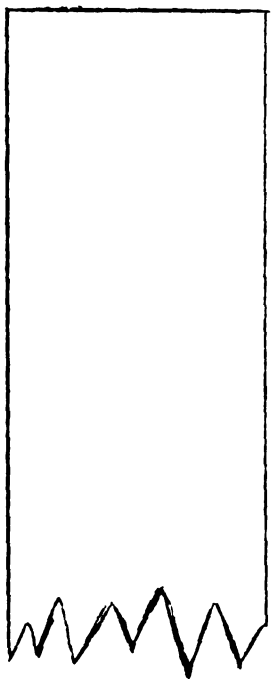
Source: Dr. Henry Foth, Department of Soils, Michigan State University.

Name_____

Section_____

Horizon properties & remarks

Draw in horizon boundaries and designations.



The nature of the soil forming factors responsible for the formation of this soil are:

Climate _____ Classification of soil:

Native Vegetation _____ Soil Type _____

Parent Material _____ Great Soil Group _____

Topography _____ Geographical Location: _____

_____

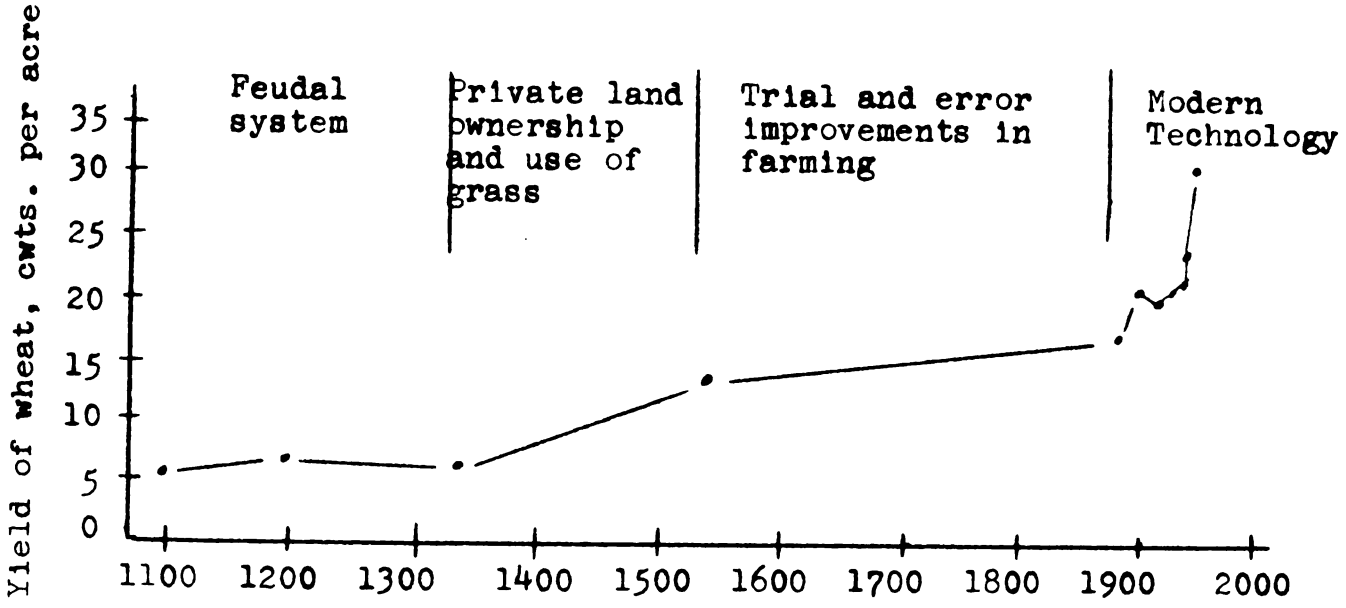
Time _____

Remarks:

The Great Soil Groups of North America
(for location see map on p. 94 in text)

reat Soil Groups	Climate	Vegetation	Characteristics of soil	Best Use
Tundra	Cold and low rainfall	Lichens, moss, sedges and flowering plants	High in organic matter and wet. Drainage limited by permafrost	Grazing of reindeer for meat
Podzol	Cool - humid	Coniferous forests	Low in fertility and acid	Forestry, recreation and short season crops
Gray-brown podzolic	Warm - temperate	Deciduous forests	Moderate fertility and mildly acid	General farming
Red-yellow podzolic	Warm - humid	Deciduous and coniferous forests	Low in nutrients and subject to erosion	General farming and forestry
Prairie (Brunizem)	Humid - temperate	Tall grasses	Very fertile, high in organic matter and little leaching	Corn and other cereal grains
Blackerths (Chernozem)	20-30" annual rainfall	Mixed prairie grasses	High in organic matter and nutrients	Wheat and other cereal grains
Brownerths	Arid to semi-arid, 10-20" annual rainfall	Bunch on short grasses	Fertile but lacking in moisture	Controlled livestock grazing
Desert	Hot-Arid, under 10" annual rainfall	Desert scrub and cacti	Nutrients high, low in moisture and organic matter	Irrigated crops

Wheat yields in Britain, 1100 to 1960



From: Journal of Soil and Water Conservation of 1962.

(Handout issued by Dr. Henry Foth to supplement his lecture)

FORESTS OF MICHIGAN

State Forests

Upper Peninsula

State Forest	County	Acreage
Baraga	Baraga, Keweenaw, Houghton, Ontonagon	131,197
Escanaba River	Alger, Marquette	163,682
Grand Sable	Alger, Schoolcraft	202,391
Iron Range	Gogebic, Iron	77,051
Lake Superior	Chippewa, Luce	224,949
Mackinac	Chippewa, Luce, Mackinac	308,939
Manistique River	Alger, Delta, Schoolcraft	163,873
Menominee	Delta, Menominee	123,553
Michigamme	Alger, Marquette	116,839
Munuscong	Chippewa, Mackinac	116,866
Sturgeon River	Dickinson	215,802
	Total	1,845,142

Lower Peninsula

Allegan	Allegan, Barry	32,416
Alpena	Alpena, Alcona, Iosco	74,510
Au Sable	Crawford, Kalkaska	290,432
Black Lake	Cheboygan, Presque Isle, Bois Blanc Island	145,906
Chippewa River	Isabella, Mecosta, Midland, Osceola	60,698
Fife Lake	Benzie, Grand Traverse, Leelanau, Manistee, Wexford	188,939
Hardwood	Emmet, Cheboygan	188,484
Houghton Lake	Clare, Missaukee, Roscommon	325,492
Ogemaw	Arenac, Bay, Gladwin, Ogemaw	181,882
Pere Marquette	Lake, Mason, Muskegon, Newaygo, Oceana	59,724
Pigeon River	Antrim, Charlevoix, Otsego	176,157
Thunder Bay Riv.	Montmorency, Oscoda	189,437
	Total	1,914,077
	Grand Total	3,759,219

Source: Michigan Forests Facts. Forestry Division, Department of Conservation, 1958.

NATIONAL FORESTS IN MICHIGAN

Name	Unit Headquarters	Counties	Acreage
Hiawatha	Escanaba	Delta, Schoolcraft, Marquette, Alger	475,976
Huron	Cadillac	Oscoda, Alcona, Iosco, Ogemaw, Crawford	415,927
Manistee	Cadillac	Wexford, Manistee, Mason, Lake, Oceana, Newaygo, Mecosta, Muskegon	444,116
Marquette	Escanaba	Chippewa, Mackinac	352,864
Ottawa	Ironwood	Baraga, Gogebic, Houghton, Iron, Ontonagon	853,441

SCHOOL AND COMMUNITY FORESTS

658 school forests cover 67,400 acres; 225 community forests include 110,000 acres. Most of these forests are started from bare ground and are built up from small annual plantings. They are established primarily for educational and recreational purposes.

Source: Michigan Forest Fact, Forestry Division, Department of Conservation, 1958.

WILDLIFE EXTINCT OR THREATENED

Extinct species	Extinction date	Threatened species
Michigan grayling	1930	Great white heron
Great auk	1853	Trumpeter swan
Pallas cormorant	1852	California condor
Heath hen	1931	Mississippi kite
Passenger pigeon (A specimen was kept in captivity until 1914)	1898	Red bellied hawk
Carolina paraquet	1904	Sage hen
California grizzly	1900	Whooping crane
Sea mink	1860	Ivory billed woodpecker
Arizona elk	1901	Grizzly bear
		Sea otter
		Wolf and cougar
		Sierra Bighorn
		Rock sturgeon

Source: Leonard W. Wing, Practices of Wildlife Conservation (New York: Wiley, 1951), p. 134.

PRESENT WILDLIFE RESOURCES

Farm Wildlife

Cottontail rabbit, squirrels and fur bearers; Bobwhite quail, ringnecked pheasant and Hungarian partridge.

Forest and Range Wildlife

White-tailed deer, mule deer, black-tailed deer, antelope and black bear; wildturkey, sharp-tailed grouse, ruffed grouse, and gray squirrel; coyotes, wolves, cougars, gray foxes, bobcats, and black bears.

Wilderness Wildlife

Grizzly bear, moose, mountain sheep, mountain goat and trumpter swan; lynx, fisher, martin and wolverine.

Migratory Wildlife

Song and insectivorous birds; shore birds, ducks, geese and doves.

Resident Aquatic Wildlife

Muskrat, beaver, mink, otter and raccoon.

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W. K. KELLOGG BIRD SANCTUARY . . . of Michigan State University

Telephone: Area Code 616 671-5721

Route 1, Augusta, Michigan

LOCATION

Located in Northeastern Kalamazoo County on the east side of Gull Lake, one mile north of M-89.

FACTS OF INTEREST

* Five farms, comprising Section 8, Ross Township, and encompassing Wintergreen Lake, were purchased in 1926 by the late W. K. Kellogg.

* The Sanctuary was operated as a private sanctuary for over two years and on January 1, 1930, was deeded to Michigan State College.

* The development of the Kellogg flock of Canada Geese began to attract migrant geese in 1935. They have branched out to nest in an area whose radius extends for over 20 miles. This example has been repeated in many parts of Michigan and the Midwest.

* Plantations to control erosion, wildlife habitat plantings, and conservation farming express how Man, with the help of Mother Nature, can transform a marginal area into a land of functional use and natural beauty.

* During the past 30 years, over 3 million people have come to visit the project. Presently, over 200,000 visit the Sanctuary each year. Every state in the United States is logged by early Fall, along with over 50 foreign countries.

* The Kellogg Foundation provided a generous gift in 1960 to replace and up-grade the physical plant, in keeping with the increased visitation and academic use of the area.

OBJECTIVES

TO.....demonstrate the functions and programs of a wildlife sanctuary, with emphasis on native species.

TO.....serve as a field laboratory where basic and applied research studies can be carried out which will provide information for better management of our natural resources.

TO.....carry out a science and outdoor education program for teachers, students, farmers, sportsmen, etc.

TO.....help stimulate interest in conservation principles and attempt to awaken an inert desire on the part of the general public to more fully appreciate and make wise use of the out-of-doors.

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F SPECIAL INTEREST

** Educational Programs in Auditorium

Tapes, slides, and films:

"Knowing Our Birds" (35 min)
"The Sanctuary Story" (24 min)
"The Sanctuary's Conservation Story" (18 min)
"Waterfowl and Conservation Practices" (24 min)
"Baker Sanctuary Story" (36 min)
"Kalamazoo Valley Story" (28 min)
"A Visit To The Kellogg Sanctuary" (15 min)
"Honker Haven" (25 min)
"Beyond Your Doorstep" (27 min)

** Waterfront Display

.....Dabbling Ducks and Diving Ducks.....
over 30 species of ducks, geese, swan, and cranes in the live collection. Demonstration of nesting islands, protected loafing structures, duck houses,etc.

** Wintergreen Overlook

.....Protective shelter housing interpretive displays.....

* What is a bird
* Habitat display
* Migration crossroads
* Plumage development
** Diving vs Dabbling ducks *
** Adaptations of bills & feet *
** Kellogg flock development *
** Bands & banding techniques *

** Birds of Prey

Large flying pens house our representative hawks, owls, and eagles.

** Native Animals

A few species of our native animals are also on display.

** Demonstration Plantings

Demonstration plantings of food and cover-producing plants, shrubs, and trees can be seen. Many are labeled for easy identification.

** Conservation Classroom

Dioramas on Lake Productivity, Soil, Plants, and Water Profile, and Land and Aquatic Insects.

** Demonstration Waterfowl Shelter

For game breeders and waterfowl research interests. Also used to winter experimental and less hardy waterfowl.

SPECIAL SERVICES

** Reception Center - office, bookshop, and information desk.

** Spruce Lodge - a rustic building overlooking Wintergreen Lake. For adult group meetings. Reservations necessary.

** Guided Tours - for groups, preceded by a film or slide program in the auditorium. Reservations necessary.