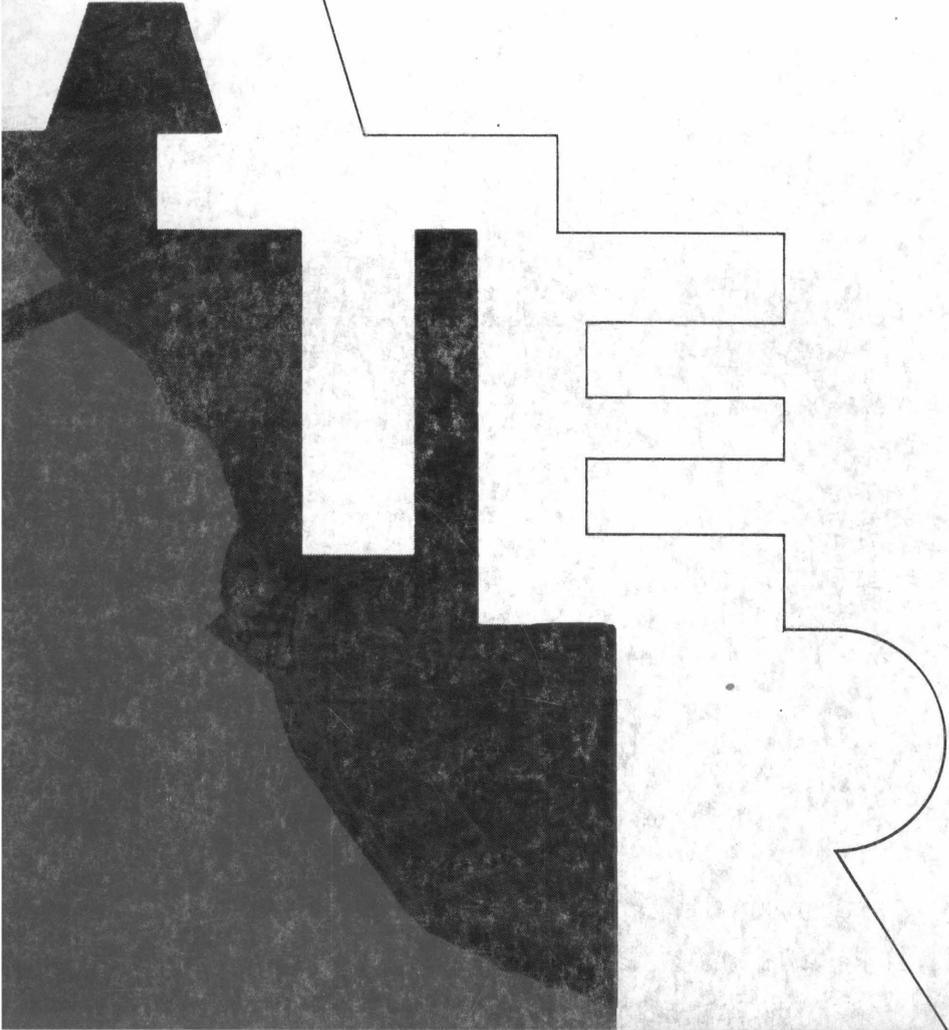


Bulletin 49
WATER RESOURCES RESEARCH
IN VIRGINIA - 1969-1971
William R. Walker
T. W. Johnson



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WATER RESOURCES RESEARCH
IN VIRGINIA - 1969-1971

William R. Walker
T. W. Johnson
Editors

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Water Resources Research Center
Virginia Polytechnic Institute
and State University
Blacksburg, Virginia
April 1972

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PREFACE

The initial publication by the Virginia Water Resources Research Center, Bulletin 1, "Water Resources of Virginia — Inventory of Printed Information and Data," was issued in March 1966. It was designed to identify the major research efforts devoted to the state's water resources. Since the Water Center is committed to using the expertise of the faculties of the institutions of higher learning, the areas of competence in each of these institutions were then identified. This material was published in 1968 as Bulletin 17, "Water Resources Research Interests in the Colleges and Universities of Virginia." Faculty and faculty research interests continually change and those that have occurred since 1968 are reflected in this bulletin.

The format of Bulletin 17 was modified for Bulletin 49 in an effort to increase its usability. Research conducted during the past three years, along with ongoing research, is listed by department within each College or University. The research is indexed by topic, and publications emanating from the research efforts are cataloged by author under the various sponsors.

William R. Walker
Director

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**Bridgewater College
Bridgewater, Virginia 22812**

TITLE

Comparative Study of North River Above and Below Discharge of Sewage Treatment Plant at Town of Bridgewater

PROJECT DIRECTOR

Harry G. M. Jopson, Ph.D. — Department of Biology

TERM

October 1, 1971 —

SPONSOR

Bridgewater College, Department of Biology

OBJECTIVES

The impact of the sewage treatment plant of the Town of Bridgewater is being evaluated by a study of plankton and bottom fauna above and below the point of discharge of the effluent.

Lynchburg College
Lynchburg, Virginia 24500

TITLE

Improving Instruction in Environmental Studies Through Development of Lynchburg College Lake as an Instructional Laboratory

PROJECT DIRECTORS

Gwynn W. Ramsey, Ph.D. – Biology Department

Walter Guy Rivers, Ph.D. – Biology Department

TERM

Summer 1971 to August 1973

SPONSOR

Kellogg Foundation

FUNDING

Sponsor: \$15,010

OBJECTIVES

Eight field-oriented courses will combine efforts to study Lynchburg College Lake (about 15 acres) to determine the nature of factors causing pollution and siltation. Data will be gathered and conclusions drawn.

CONCLUSIONS

Some basic studies were started during the spring semester of 1971. Students in several field-oriented courses made preliminary studies on the (1) aquatic flora, (2) fish fauna, (3) pollution indicator organisms, and (4) siltation problems. A hydrographic map was prepared by using the Sounding-Survey Method. All of these studies will be continued.

RELEVANCE

The information will be used for instructional purposes not only for Lynchburg College, but also for the surrounding metropolitan area. The result of this activity will be a unified effort by diverse courses to study a changing system and to develop a natural resource into a functional, instructional laboratory.

**Mary Washington College
Fredericksburg, Virginia 22401**

TITLE

Rappahannock River Project

PROJECT DIRECTOR

Samuel O. Bird, Ph.D. — Geology Department

TERM

January 1, 1971 to January 1, 1974

SPONSOR

NSF-COSIP

FUNDING

NSF-COSIP: \$34,000; Mary Washington College: \$5,000

OBJECTIVES

The biological populations of the Rappahannock River and several of its tributaries are being studied. Chemical tests of interest to the biologist are also being performed. It is hoped that the normal flora and fauna can be established so that the river can be monitored for natural or man-made environmental changes.

CONCLUSIONS

Preliminary studies have not been analyzed.

RELEVANCE

To improve the environment, knowledge of our local resource is needed so that we can evaluate any physical or biological changes.

**Old Dominion University
Norfolk, Virginia 23508**

TITLE

Biological Survey of the Southern Branch of the Elizabeth River

PROJECT DIRECTOR

Harold G. Marshall, Ph.D. — Department of Biology

TERM

September 1971 —

OBJECTIVES

The southern branch of the Elizabeth River is being studied to determine the pesticide concentration of the trophic levels present and to analyze the plankton composition and its contribution to the ecosystem.

CONCLUSIONS

Since data are still being collected, no conclusions have been drawn.

RELEVANCE

This work will contribute to a greater understanding of pesticide concentration and distribution in a local waterway.

TITLE

The Effect of Periodic Burning on Marshland Productivity

PROJECT DIRECTOR

James F. Matta, Ph.D. — Department of Biology

TERM

June 1, 1971 to January 1, 1972

OBJECTIVES

The effect of periodic burning both on the species composition of marsh insect populations and on the productivity of marsh communities in terms of the insect population is being determined.

CONCLUSIONS

Data analysis is not yet complete.

RELEVANCE

Despite the common usage of controlled burning as a means of increasing productivity in marsh situations, little work has been done on the relative productivity of burned and unburned marsh areas. This preliminary study will give some insight into the effect of fire on insect populations which serve as a significant food source for many marsh residents and migratory waterfowl. An anticipated result is that this study will lead to some modification in marsh burning procedures and will indicate areas for further study.

TITLE

An Integrated Study of the Northwest River and Its Watershed

PROJECT DIRECTORS

Gerald F. Levy, Ph.D. — Department of Biology

Robert L. Ake, Ph.D. — Department of Chemistry

Randall S. Spencer, Ph.D. — Department of Geology

TERM

June 1, 1971 to September 1, 1971

SPONSOR

National Science Foundation

FUNDING

Sponsor: \$4,000

OBJECTIVES

Collection, identification, and mapping of area aquatic and terrestrial flora and fauna; chemical analysis of soil and water; and data collection concerning surface and subsurface hydrological features were used to determine possible uses of the river. These data will also provide input for a proposal for a long-term, in-depth study.

CONCLUSIONS

Distribution of flora and fauna, analysis of soil and water, and collection of hydrological data have been completed. The findings have not yet been analyzed.

RELEVANCE

This study will provide data that will be useful in helping local officials faced with the dilemma of determining (without adequate information) the feasibility of constructing a dam and reservoir on the Northwest River. It should also add knowledge to the generally poor understanding of the ecology and hydrology of this area, as well as provide the basis for a long-term, in-depth study of this area which will be the subject of a future research proposal.

TITLE

Plankton Study of the Lafayette River

PROJECT DIRECTOR

Harold G. Marshall, Ph.D. — Department of Biology

TERM

September 1970 —

OBJECTIVES

The seasonal composition of plankton and their inter-relationships to environmental conditions are being determined.

CONCLUSIONS

Data are still being collected.

RELEVANCE

The data will provide information on basic ecological relationships in the Lafayette River.

TITLE

Seasonal Study of Lake Drummond

PROJECT DIRECTOR

Harold G. Marshall, Ph.D. — Department of Biology

TERM

June 1970 —

OBJECTIVES

Objectives are a limnological study of the seasonal fluctuations and an analysis of the phytoplankton composition and seasonal distribution in Lake Drummond.

CONCLUSIONS

Seasonal phytoplankton successional patterns have been determined with emphasis placed on correlations with environmental factors and successional inter-relationships.

RELEVANCE

This study offers significant data on the productivity and nature of Lake Drummond.

PUBLICATIONS

Marshall, H. and W. Poore (1971). "Phytoplankton Composition at Lake Drummond in the Dismal Swamp"; Castanea; 8 pp. (In Press).

TITLE

A Study of the Northwest River and Its Watershed

PROJECT DIRECTORS

Gerald F. Levy, Ph.D. — Department of Biology
Randall Spencer, Ph.D. — Department of Geology
Robert Ake, Ph.D. — Department of Chemistry

TERM

June 1, 1971 to August 31, 1971

SPONSOR

NSF-COSIP

FUNDING

NSF-COSIP: \$2920; Old Dominion University: \$1000

OBJECTIVES

The general botanical, chemical, and geological characteristics of the Northwest River watershed are being identified.

CONCLUSIONS

The size of the watershed was determined, the forests of the area were sampled quantitatively, and a map of the forests and other land-use patterns was made. Various parameters of water chemistry, including pH, macronutrients, various micronutrients, and chlorinated hydrocarbon pesticides, were measured. Relationships between rainfall as measured by a network of gauges, one per two square miles, were correlated with river level and rate of flow. Gravity measurements were made, and ground water wells were established and monitored. Data are still being evaluated.

RELEVANCE

The Northwest River has been proposed for impoundment to provide a source of drinking water for the City of Chesapeake. Because questions of ecological damage have been raised and no basic research data is available for this watershed, this study was conducted to provide some of this basic data.

TITLE

Tidal Shoaling in the Entrance to Chesapeake Bay, Virginia

PROJECT DIRECTOR

John C. Ludwick, Ph.D. — Institute of Oceanography

TERM

November 1969 —

SPONSOR

Office of Naval Research

FUNDING

Office of Naval Research: \$37,000; Institute of Oceanography, Old Dominion University: \$40,000

OBJECTIVES

Determine the relationship between large migrating sand waves and the growth of large sediment shoals in the entrance to tidal estuaries.

CONCLUSIONS

Data from 21 successive echo-sounding profiles, taken over a 17-month period, show that the seaward-facing asymmetrical sand waves are migrating seaward. Rates of migration of these waves range from 115 to 492 feet per year. Symmetrical sand waves did not show significant migration. Sand wave height changes seasonally, with trochoidal waves experiencing a two-fold height change. Small heights occur from October to late April when surface water waves are frequently higher than 5 ft; large sand wave heights occur from May to September, particularly during the latter month when surface water waves are usually lower than 5 ft in height.

Prominent shoals in the entrance area characteristically have ebb-dominated near-bottom tidal currents on one side and flood-dominated near-bottom tidal currents on the other side. This pattern is suggestive of a sand circulation conjoint with the shoal. Geomorphic evidence is consistent with the existence of such sand circulation cells. The circulation mechanism would explain how the shoals maintain their positions in the face of strong tidal currents and heavy wave action.

RELEVANCE

Shoaling of navigation channels requires expensive dredging. Research into the causes of shoaling will ultimately lead to methods of control of shoaling. The present research shows that sand migrates on some large shoals in the form of mammoth sand waves. These waves of sand move at the rate of several hundred feet per year.

PUBLICATIONS

Ludwick, J. S. (1970) "Sand Waves in the Tidal Entrance to Chesapeake Bay: Preliminary Observations"; Chesapeake Science; Vol. 11, No. 2; pp. 58-110.

Luc vick, J. C. (1970) "Sand Waves and Tidal Channels in the Entrance to Chesapeake Bay"; Virginia Journal of Science; Vol. 21, No. 4; pp. 178-184.

Ludwick, J. C. (1970) "Sand Waves and Tidal Channels in the Entrance to Chesapeake Bay"; Old Dominion University, Institute of Oceanography, Tech. Report; No. 1; 107 pp.

**Randolph-Macon Woman's College
Lynchburg, Virginia 24504**

TITLE

Ecological and Sociological Aspects of the Proposed Blackwater Creek Park in Lynchburg, Virginia

PROJECT DIRECTORS

Franklin F. Flint, Ph.D. — Department of Biology
Miss Anne H. Lindsey — Student Project Director

TERM

June 1971 to April 1972

SPONSOR

National Science Foundation

FUNDING

Sponsor: \$16,760

OBJECTIVES

The Blackwater Creek Basin in Lynchburg has been proposed as the site for a linear park which, unlike the average city park, would follow the recent developments in Richmond and Norfolk, Virginia. The park, in essence, would be developed as a natural preserve with hiking trails, bridle paths, some picnic grounds, ball fields, an Ecological Study Center, and various proposed "future" plans for an amphitheater, development of an old Civil War site, and reconstruction of Hollins Mill. Though much of the length of the proposed park land — from College Lake to Hollins Mill — is narrow and confined to foot trails and the creek, expanded areas exist in the Gibson tract, off Monticello Avenue, and an enlarged tract of land stretching behind Lynchburg General Hospital.

The entire study was divided into six areas: flora and fauna survey; ecological survey including soil analysis and quadrat study of forest types; water analysis; microbial analysis including bacterial, fungal, and algal studies; and a sociological survey designed to determine attitudes of the people to the proposed park.

CONCLUSIONS

From all indications the six groups have produced favorable results concerning establishment of the park. The flora and fauna surveys revealed unusual diversity in the proposed park land which is typical of the terrain in the Piedmont of Virginia; and it is significant that this diversity is included in such a small area. The ecology survey concurs with the flora and fauna studies. Pre-oak-hickory climax forests dominate the park. Though rich in flora and fauna, the soil is considered poor quality, at least for agriculture. The ecology team considers development of the park for commercial use impractical.

The water analysis and microbiology teams have concurred in finding Blackwater Creek marginally polluted, mainly by a dilapidated sewer system running the length of the creek and along College Lake. Suggestions from these groups indicate that if the sewer system is repaired, the creek will improve noticeably.

The sociology team's sampling results indicate a favorable attitude toward the installation of the Blackwater Creek Park. The sample is representative of the Lynchburg population and proved that those facilities as proposed by the city planning office are acceptable to a majority of the people.

RELEVANCE

College Lake (actually an impoundment of Blackwater Creek) and its banks have been studied by faculty and students of Lynchburg College, but there has been no such study of Blackwater Creek extending from the lake. A knowledge of the physical environment of the area was felt necessary to determine whether the land was appropriate for a natural preserve park. Also, a study to determine attitudes of the Lynchburg populace towards establishing a new park within the center of the city was considered important.

PUBLICATIONS

Flint, Franklin F., Project Advisor (1971) Ecological and Sociological Aspects of the Proposed Blackwater Creek Park in Lynchburg, Virginia; Student-originated study sponsored by the National Science Foundation.

Lindsay, Anne H. (1971) "Ecological Study of Blackwater Creek Basin, Preliminary to Its Development as a Park in Lynchburg, Virginia"; Paper presented to the American Association for the Advancement of Science, Philadelphia, Pa.

Roanoke College
Salem, Virginia 24153

TITLE

Systematics and Distribution of Freshwater Fishes of Virginia and Adjacent Areas

PROJECT DIRECTOR

Robert E. Jenkins, Ph.D. — Biology Department

TERM

January 1, 1968 —

SPONSOR

Roanoke College, Virginia Academy of Science

FUNDING

Roanoke College: ~\$400; Virginia Academy of Science: \$400

OBJECTIVES

Various groups and species of Virginia freshwater fishes are under study to determine the composition of the Virginia freshwater fish fauna and the distribution of its species. Knowledge of the life history of certain species is an objective of the project. A result of the study will be the description of new species and a determination of their relationships.

CONCLUSIONS

The known freshwater fish fauna of Virginia includes at least 180 species, a fairly high total among state faunas of the United States. As of July 1971, the fauna is known to consist of 5 undescribed species. At least 9 species are under serious consideration for placement on the U.S. Fish and Wildlife Service list of rare and endangered species. The existence of the 9 species is threatened by impoundments and/or pollution.

RELEVANCE

For several reasons a knowledge of the composition of the Virginia freshwater fish fauna is important. First, while many of the species are not game or food fishes, some are important forage, and understanding of their biology and distribution is important for management of our waters. Second, the success of all species, whether economically important or not, relates to the quality of their environment. Finally, several species have been recognized as rare and endangered, an indication of a need for better conservation of inland waters than has been exercised in the past.

PUBLICATIONS

Jenkins, R. E. (1970) Systematic Studies of the Catostomid Fish Tribe Moxostomatini; Ph.D. Thesis; Cornell University, Ithaca, New York; 818 pp.

Jenkins, R. E. (1970) "Zoogeography and Characters of the American Cyprinid Fish *Notropis bifrenatus*"; Chesapeake Science; Vol. 11, No. 3; pp. 174-182.

Jenkins, R. E., E. A. Lachner, and F. J. Schwartz (in press) "Fishes of the Central Appalachian Drainages: Their Distribution and Dispersal"; *In* The Distributional History of the Biota of the Southern Appalachians. Part 3: Vertebrates; P. C. Holt and J. P. Hubbard, Eds., Research Division Monographs, Va. Polytechnic Institute and State University.

Lachner, E. A. and R. E. Jenkins (1971) "Systematics, Distribution, and Evolution of the Chub Genus *Nocomis* Girard (Pisces, Cyprinidae) of Eastern United States, with Descriptions of New Species"; Smithsonian Contributions to Zoology; No. 85; 97 pp.

Taylor, W. R., R. E. Jenkins, and E. A. Lachner (1971) "Rediscovery and Description of the Ictalurid Fish *Noturus flavipinnis*"; Proc. Biol. Soc. Wash.; Vol. 38, No. 41; pp. 469-476.

University of Virginia
Charlottesville, Virginia 22903

TITLE

An Anaerobic-Aerobic Lagoon for Treating Vegetable Tannins

PROJECT DIRECTOR

C. E. Parker, Ph.D. — Department of Civil Engineering

TERM

July 1, 1967 to June 30, 1970

SPONSOR

U.S. Department of the Interior

FUNDING

Water Quality Office, Environmental Protection Agency: \$48,084; University of Virginia: \$9,594; other support: \$17,250.

OBJECTIVES

The areas of research included a study of the physical, chemical, and biological factors of an anaerobic-aerobic lagoon in treating spent tannins neutralized with other tannery waste streams; the development of measures to evaluate the ability of such a lagoon to assimilate tannery wastes under controlled conditions; and the analysis of the present and potential future development of such a lagoon as a full scale treatment method for tannery waste. Although this approach to treating tannery waste has proven feasible in laboratory bench systems, it has not been demonstrated by a pilot field system.

CONCLUSIONS

A field demonstration lagoon was operated at Virginia Oak Tannery, Inc., Luray, Virginia, to evaluate the effectiveness of an anaerobic-aerobic lagoon in treating spent vegetable tannins blended with batepool and soak waste waters. The anaerobic-aerobic lagoon system was used to treat combined waste streams with a BOD⁵ concentration of approximately 1000 mg/l. Operational phases were designed to cause the system to go from aerobic conditions to anaerobic-aerobic. After reaching anaerobic-aerobic conditions, doubling the BOD⁵ load did not result in a significant decrease in BOD⁵ removal efficiency. Efficiency, measured in terms of soluble BOD⁵, at a BOD⁵ load of 17.3 lbs/1000 ft³/day (anaerobic-aerobic condition) was 81% compared to a 92% efficiency for a BOD⁵ load of 4.5 lbs/1000 ft³/day (aerobic conditions).

Although the lagoon system proved successful in removing degradable organics, color of the waste water was not reduced by this method of treatment. Color of spent vegetable tannins is a major problem and will dictate the most desirable approach to treating this waste water.

A completely mixed aeration unit was used in the laboratory to study the biological degradation of spent vegetable tannins. It was found that approximately 60% of the COD of spent vegetable tannins is not biologically degradable and the generally accepted substrate-growth interaction relationship required modification to take into account the non-degradable fraction of COD.

RELEVANCE

Tannery wastes are large in volume; however, about 1/3 of the BOD is concentrated in spent tannins which account for only 10% of the flow. Since no completely satisfactory method has been devised for treating tannery wastes, a suitable treatment was desperately needed. An effective economic method of treating these wastes was essential for the industry to survive and to meet new pollution abatement standards. Therefore, it was desirable to examine a field scale treatment method capable of treating these concentrated wastes. Results from this work have led to a better understanding of tannery waste treatment and have provided significant information for tannery waste treatment design.

PUBLICATIONS

Parker, C. E. (1970) "Anaerobic-Aerobic Lagoon Treatment for Spent Vegetable Tanning Wastes"; Federal Water Quality Administration, Grant No. WPD-199-01-67, Research Laboratories for the Engineering Sciences, University of Virginia.

Parker, C. E. (1970) "Biological Treatment of Spent Vegetable Tannins"; Proceedings of the 25th Ind. Waste Conference, Purdue University.

Parker, C. E. (1971) "Treatment of Spent Vegetable Tannins by Lagooning"; Journal of the American Leather Chemists; Vol. LXVI, No. 2.

Parker, C. E. and I. H. Thaker (1969) "A Study of Kinetic Parameters Using Spent Vegetable Tannins"; Proceedings of the 3rd Mid-Atlantic Ind. Waste Conference, University of Maryland.

TITLE

Convection Heat Transfer from Water Surfaces

PROJECT DIRECTORS

J. T. Beard, Ph.D. – Mechanical Engineering Department

C. S. Chen, Ph.D. – Mechanical Engineering Department

TERM

July 1, 1969 to September 15, 1971

SPONSOR

Office of Water Resources Research, U.S. Department of the Interior, Project B-021-VA

FUNDING

Office of Water Resources Research: \$25,177; University of Virginia: \$25,177

OBJECTIVES

Analytical and experimental studies were made to determine the various relations for heat transfer from a liquid water surface. The coupled energy, diffusion, momentum, and continuity equations were solved with the aid of an analog computer. Experimental verification of analytical relations were made through use of a Mach Zehnder Interferometer.

CONCLUSIONS

First, in co-current air and water flow, the interfacial motion enhances the heat transfer and evaporation. This is due to increased convective heat and mass removal resulting from the increased velocities in the boundary layer close to the interface.

Second, analog computers may be used to solve certain classes of boundary layer equations, especially where similarity transformations can be used to reduce the partial differential equations to ordinary differential equations.

RELEVANCE

Previously, very little research has been done to study the heat transfer and mass transfer mechanisms from a liquid-air interface. This research has been important not only to provide the conclusions listed above, but also to open up this research field. Such research must be done to provide better information for solution of thermal pollution problems.

PUBLICATIONS

Beard, J. T., C. S. Chen, and C. Prasad (1971) Convective Heat and Mass Transfer from Water Surfaces; Bulletin 47, Virginia Water Resources Research Center, VPI&SU, Blacksburg, Virginia.

Prasad, C. (1971) Heat Transfer from an Air-Water Interface; Ph.D. Thesis, Mechanical Engineering Department, University of Virginia, Charlottesville, Virginia.

Prasad, C., C. S. Chen, and J. T. Beard (1971) "Analytical and Experimental Studies of Heat and Mass Transfer from an Air-Water Interface"; paper 3-4, presented at International Symposium on Two-Phase Systems, Technion City, Haifa, Israel.

Prasad, C., C. S. Chen, and J. T. Beard (1971) "Convective Heat and Mass

Transfer Studies from an Air-Water Interface"; to be presented at Winter Annual Meeting of ASME in Washington, D.C.

Prasad, C., C. S. Chen, and J. T. Beard (1971) "Interferometric Technique for Temperature and Concentration Measurement for an Air-Water Interface"; Transactions of the ASME; Vol. 93, Series D, No. 2; pp. 185-191.

TITLE

Solar Reflectance of Monolayer Covered Water Surfaces

PROJECT DIRECTOR

J. T. Beard, Ph.D. — Mechanical Engineering Department

TERM

September 1, 1967 to September 30, 1969

SPONSORS

Office of Water Resources Research, U.S. Department of the Interior, Project A-019-VA; Bureau of Reclamation

FUNDING

Office of Water Resources Research: \$12,425; University of Virginia: \$5,063; Bureau of Reclamation: \$24,151

OBJECTIVES

Research was done to search for a chemical substance which would substantially increase the solar reflectance of lake surfaces as a technique for evaporation suppression, and an analytical study was made with a digital computer to calculate the changes in evaporation losses which will accompany changes in solar reflectance.

CONCLUSIONS

First, a considerable search was made for substances which would either form a monolayer or a stable film on a water surface. One such material, Union Carbide Experimental Silicone S-1362-91-2, was found to reflect solar energy 70% better than a plain water surface. The only materials found to result in greater reflectances were oils which are obviously undesirable from the standpoint of water pollution.

Second, a computer study was made to calculate the decrease in evaporation which will occur with the application of reflecting films and monolayers. This study showed that for reflecting films to be effective as evaporation suppressors, they would also have to act as diffusion barriers.

RELEVANCE

Although it is conceivable that a reflecting film or monolayer can be found which would greatly reduce evaporation of water from reservoirs and ponds, this study did not locate one. This study did illustrate the importance of the film and monolayer to act as a diffusion barrier for the reduction of evaporation. Also, this study proved again the importance of solar radiant energy in the problem of evaporation.

PUBLICATIONS

Beard, J. T. (1971) "Discussion of Comments of S. B. Idso"; Journal of Geophysical Research; Vol. 76, No. 12; p. 2901.

Beard, J. T. and J. L. Gainer (1970) "Influence of Solar Radiation Reflectance on Water Evaporation"; Journal of Geophysical Research; Vol. 75, No. 27; pp. 5155-5165.

Beard, J. T. and D. K. Hollen (1969) Influence of Solar Radiation Reflectance on Water Evaporation; Bulletin 30, Virginia Water Resources Research Center, VPI&SU, Blacksburg, Virginia.

Chen, C. S. and J. T. Beard (1970) "Thermal Studies for Heated Water Systems"; Proceedings National Symposium on Hydrobiology, Paper No. 7, American Water Resources Association, Miami, Florida.

Gainer, J. L., J. T. Beard, and R. R. Thomas (1969) Water Evaporation Suppression; Bulletin 27, Virginia Water Resources Research Center, VPI&SU, Blacksburg, Virginia.

Hollen, D. K. (1969) Reflectance of Water Surfaces; Master's Thesis, Mechanical Engineering Department, University of Virginia, Charlottesville, Virginia.

**Virginia Commonwealth University
Richmond, Virginia 23220**

TITLE

Ammonia as a Significant Nitrogen Source for Freshwater Ecosystems

PROJECT DIRECTOR

Gene L. Samsel, Jr., Ph.D. – Department of Biology

TERM

September 1, 1971 to September 1, 1973

OBJECTIVES

Research being conducted compares data collected in Antarctica (concerning the possible role of ammonia as the most important nutrient in causing accelerated eutrophication) with data collected from the temperate zone, such as freshwater habitats in southeastern Virginia. Avenues of transport of NH_4^+ and preferential users are also being evaluated.

CONCLUSIONS

Although research is not complete, preliminary results from two oxidation ponds, near Ashland, Virginia, indicate more rapid stimulation of carbon fixation by phytoplankton when enriched with NH_4^+ – more so than with PO_4 , NO_3 , SO_4 , etc.

RELEVANCE

If NH_4^+ , which has several important avenues of transport (in solutions, from precipitates, or airborne), is shown to be a significant source of N for primary producers in aquatic locales, much more effort needs to be devoted to the study of this nutrient.

PUBLICATIONS

Samsel, Gene L. "Ammonia as a Significant Nitrogen Source for Antarctic Freshwater Ecosystems. I. Uptake and Effects"; Abstract; ASB Bulletin; 18(2):53.

----- "Ammonia as a Significant Nitrogen Source for Antarctic Freshwater Ecosystems. II. Origin and Transport"; Abstract; ASB Bulletin; 18(2):63.

----- "Nutrient Factors Limiting Primary Productivity in Simulated Antarctic Microecosystems"; Bioscience; (In Press).

TITLE

An Ecological Investigation of the Lower North Anna and Upper Pamunkey River System

PROJECT DIRECTORS

George M. Simmons, Jr., Ph.D. — Department of Biology

James R. Reed, Jr., Ph.D. — Department of Biology

TERM

June 1, 1971 to August 30, 1971

SPONSOR

Virginia Electric and Power Company

FUNDING

Virginia Electric and Power Company: \$11,400; Virginia Commonwealth University: ~\$600

OBJECTIVES

Studies were conducted to find the biological recovery zone of the North Anna River to evaluate future effects upon the benthic community in the river of heated waste discharge from the North Anna nuclear power facility and reservoir construction. The recovery zone, therefore, serves as an "environmental marker" to determine whether or not the above variables will have a positive or negative effect upon water quality in the lower North Anna and upper Pamunkey Rivers.

CONCLUSIONS

The North Anna River does not recover biologically until the confluence with the South Anna River. The confluence of these two rivers marks the beginning of the Pamunkey River. The main organisms determining recovery were two species of freshwater mussels. Although additional suitable habitats were found before the confluence, the above benthic species did not occur.

RELEVANCE

The established recovery zone serves as an "environmental marker" to evaluate the future effect of the reservoir on the North Anna River. If the reservoir and power project have a beneficial effect, the recovery zone will probably move upstream. If the reservoir and power development have a detrimental effect, the recovery zone will move farther downstream.

TITLE

A Pre-impoundment Ecological Study of the Benthic Fauna and Water Quality in the North Anna River

PROJECT DIRECTOR

George M. Simmons, Jr., Ph.D. — Department of Biology

TERM

July 1, 1969 to June 30, 1971

SPONSOR

Office of Water Resources Research, U.S. Department of the Interior, Project A-031-VA

FUNDING

Office of Water Resources Research: \$15,200; Virginia Commonwealth University: ~\$800

OBJECTIVES

Studies were made on existing water quality conditions and composition of the benthic community in relation to acid drainage in the pre-impoundment basin.

CONCLUSIONS

The North Anna River in the pre-impoundment basin has been severely polluted by acid drainage from Contrary Creek, but is in the process of recovery. Although biological assays were not performed, continued degradation appears to result from periodic influxes of heavy metals and silt from Contrary Creek. If some sort of land reclamation is initiated on Contrary Creek, the North Anna Reservoir should have a beneficial effect upon the water quality below the dam and hasten biological recovery.

RELEVANCE

Although many people in the state recognized that the North Anna River had been damaged by the drainage from Contrary Creek, the degree of severity was unknown. This study documented the degree of pollution and provided additional information regarding the ability of organisms to tolerate acid drainage. Moreover, the study illustrated how a nuclear powered hydro development can have a beneficial effect upon water quality and hasten the speed of biological recovery of a polluted river. Probably the study has been influential in helping generate a program of land reclamation on Contrary Creek.

PUBLICATIONS

Simmons, G. M. (1972) "A Preliminary Report on the Use of the Sequential Comparison Index to Evaluate Acid Mine Drainage on the Macrobenthos in a Pre-impoundment Basin"; Trans. Amer. Fish. Soc.; (In Press).

Simmons, G. M. and J. R. Reed (1971) "The Ecological Significance of Locating a Nuclear Powered Electrical Generating Facility on the North Anna River, Virginia"; Proceedings of the Third National Symposium on Radioecology; (In Press).

Simmons, G. M. and Avis Winfield (1971) "A Feasibility Study of Conservation Webbing as an Artificial Substrate in Macrobenthic Studies"; Va. Jour. Sci.; Vol. 22, No. 2; pp. 52-59.

TITLE

A Summer Study of Plankton and Nutrients in Quantico Creek and the Potomac River to Evaluate the Effect of Thermal Discharges from the Possum Point Power Station.

PROJECT DIRECTOR

George M. Simmons, Jr., Ph.D. — Department of Biology

TERM

April 12, 1971 to November 17, 1971

SPONSOR

Virginia Electric and Power Company

FUNDING

Virginia Electric and Power Company: \$8,000; Virginia Commonwealth University: ~\$1,500

OBJECTIVES

The extent to which the heated discharge from the Possum Point Power Plant is contributing to the algal bloom in the vicinity of Possum Point on the Potomac River is being determined.

CONCLUSIONS

The project has not been completed.

TITLE

Eutrophication Processes of Two Ponds in Southeastern Virginia

PROJECT DIRECTORS

Gene L. Samsel, Jr., Ph.D. — Department of Biology

James R. Reed, Jr., Ph.D. — Department of Biology

TERM

September 1, 1971 to September 1, 1973

SPONSOR

Space and laboratory facilities provided by the Health Sciences Division, Virginia Commonwealth University, at Hanover Animal Care Facility

OBJECTIVES

This project seeks to identify the succession of fauna and flora following controlled eutrophication of two oxidation ponds in southeast Virginia, to follow processes of eutrophication, and to evaluate the importance of each step.

CONCLUSIONS

The project is not complete.

RELEVANCE

The results will provide insight into the successive process of extreme water pollution, beginning with a clear, clean pond and evolving through a highly polluted oxidation system with controlled variables, such as nutrient addition and oxygenation.

**Virginia Institute of Marine Science
Gloucester Point, Virginia 23062**

The Virginia Institute of Marine Science, by virtue of its mission, is conducting research projects on varied aspects of Virginia's marine waters. These projects have been described in a VIMS publication, "Research on Chesapeake Bay and Contiguous Waters of the Chesapeake Bight of the Virginian Sea at the Virginia Institute of Marine Science, Gloucester Point, Virginia, and Wachapreague, Virginia," by William J. Hargis, Jr. This publication is available on request to Dr. William J. Hargis, Jr., Director, Virginia Institute of Marine Science, Gloucester Point, Virginia 23062. Those interested are referred to this source.

**Virginia Military Institute
Lexington, Virginia 24450**

TITLE

Ecological Survey of Woods Creek

PROJECT DIRECTOR

John H. Reeves, Ph.D. — Biology Department

TERM

September 1, 1971 to May 15, 1972

SPONSOR

National Science Foundation (College Science Improvement Program, through Biology Department, Virginia Military Institute)

FUNDING

Sponsor: \$350

OBJECTIVES

The chemical and biological effects of urbanization on Woods Creek, Lexington, Virginia, are being characterized.

CONCLUSIONS

Findings will be published upon completion of the project.

RELEVANCE

The magnitude and effect of ecological stresses caused by increasing urbanization on natural watersheds must be studied in advance of proposals to correct or ameliorate environmental degradation.

TITLE

Reliability of Sewage Treatment Plants in Virginia

PROJECT DIRECTORS

John W. Knapp, Ph.D. — Civil Engineering Department
Calmet M. Sawyer, Ph.D. — Civil Engineering Department
James M. Morgan, Jr., D. Eng. — Dean of Faculty

TERM

June 1, 1971 to May 30, 1972

SPONSOR

State Division of Water Resources

FUNDING

Sponsor: \$11,000

OBJECTIVES

Treatment reliability, as measured by the amount and percent of time that sewage treatment efficiency varies from normal or design values, is being determined for representative sewage treatment plants in Virginia.

CONCLUSIONS

Results will be published upon completion of the project.

RELEVANCE

The degree of treatment provided by sewage treatment works is not constant. The variation in flow and treatment efficiency at the plant must be known in order to predict the effect of discharges to natural streams.

TITLE

Stream Surveys in the Calf, Maury, and James Rivers

PROJECT DIRECTORS

John W. Knapp, Ph.D. — Civil Engineering
Donald K. Jamison, Ph.D. — Civil Engineering
Calmet M. Sawyer, Ph.D. — Civil Engineering

TERM

June 1, 1968 to November 15, 1970

SPONSOR

State Division of Water Resources

FUNDING

Sponsor: \$18,000

OBJECTIVES

The physical and chemical characteristics of Virginia streams below and between points of critical waste discharges were determined.

CONCLUSIONS

The data collected provided the natural characteristics of important reaches of Virginia streams for use in comprehensive river basin reports prepared by the State Division of Water Resources. Such data are necessary to determine the flow, reaeration, and waste assimilation characteristics.

RELEVANCE

Stream surveys are required to predict existing pollution levels and self-purification capacity of streams. They also provide valuable training for college students and their instructors.

PUBLICATIONS

Undergraduate theses and technical report, VMI Research Laboratories (available on request).

TITLE

Systems Analysis of Water Distribution to Field Troops

PROJECT DIRECTORS

John W. Knapp, Ph.D. — Civil Engineering Department

James M. Morgan, Jr., D. Eng. — Dean of Faculty

Donald K. Jamison, Ph.D. — Civil Engineering Department

TERM

October 1, 1969 to September 30, 1972

SPONSOR

U.S. Army Medical Research and Development Command and U.S. Marine Corps

FUNDING

Sponsor: \$64,000

OBJECTIVES

This project will develop mathematical models of potable water supply networks for troops in the field and determine optimal configurations and methods for operating field water supply systems.

CONCLUSIONS

Models have been developed and successfully applied to solve the conventional water supply network with known production, storage, and demand locations. The optimal assignment schedule for supply point distribution can be found readily in a static situation. Work continues on developing a method to locate facilities optimally in a moving combat situation.

RELEVANCE

Quick and flexible methods are needed to plan and to operate water supply systems for field troops. This research will produce techniques to solve for a logistical support system that is efficient in cost, time, and material.

PUBLICATIONS

Knapp, J. W., J. R. Sculley, J. M. Morgan, Jr., and D. K. Jamison (1970) "Analysis of Field Water Supply Systems"; Technical Report, VMI Research Laboratories.

TITLE

Wastewater Characterization Studies

PROJECT DIRECTORS

Calmet M. Sawyer, Ph.D. — Civil Engineering Department

Harry J. Pence, Ph.D. — Civil Engineering Department

TERM

November 1968 to December 1970

SPONSORS

R. Stuart Royer and Associates, Augusta County Service Authority, Cities of Lexington and Buena Vista

FUNDING

Sponsors: \$16,500

OBJECTIVES

On-site studies of waste characteristics and treatment operations were made to collect data required by regulatory agencies as the basis for future designs of treatment works.

CONCLUSIONS

Wastewater characteristics are highly variable and should be established prior to the design of treatment processes. The results of characterization studies of poultry processing wastewaters indicated that current design values, used to design pre-treatment units and municipal plants receiving combined flows, are not sufficient to prevent biological overloading of these facilities. Treatability studies indicated excessive air requirements were necessary to maintain efficient biological treatment of highly concentrated organic wastewater. Characterization of domestic wastewater indicated that biological design values are sufficient, but that the hydraulic loading of many plants is frequently exceeded by infiltration.

RELEVANCE

On-site studies of waste characteristics and treatment operations are the best way to understand the behavior of sewage treatment operations and to provide realistic data for owners, designers, and regulatory agencies. The project directors and undergraduate civil engineering students who participated in the characterization studies received practical experience in the field of applied environmental research.

PUBLICATIONS

Undergraduate theses and technical reports, VMI Research Laboratories (available on request).

**Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061**

TITLE

Penetration and Mixing of Heated Jets Injected into Waterways with Application to the Thermal Pollution Problem

PROJECT DIRECTOR

Joseph A. Schetz, Ph.D. – Department of Aerospace Engineering

TERM

July 1, 1971 to June 30, 1973

SPONSOR

Office of Water Resources Research, U.S. Department of the Interior, Project B-041-VA

FUNDING

Office of Water Resources Research: \$29,170; VPI&SU: \$32,143

OBJECTIVES

A two year, combined experimental and analytical study of the flow aspects of the thermal pollution problem is proposed. The end result of the study would be a computerized analysis that can predict the temperature distribution in a waterway adjacent to a power plant over a wide range of conditions.

CONCLUSIONS

Experimental studies show buoyancy forms are negligible for the injection of heated water from a side bank perpendicular to the main stream.

RELEVANCE

The thermal pollution problem has a very direct effect on conservation and utilization of water resources. Increased temperature upsets the ecological balance in water systems. Further, the holding capacity of the water for such quantities as dissolved oxygen can be significantly affected by increased temperature. The combination of these adverse effects can greatly disturb the ability of a waterway to maintain desirable aquatic life and to cleanse itself of pollutants.

PUBLICATIONS

Campbell, J. F. and J. A. Schetz (1971) Paper No. 71-524, 1st AIAA Urban Technology Conference.

TITLE

Effect of Detergent Polluted Water on Soils Reaction and Plant Growth

PROJECT DIRECTOR

Wybe Kroontje, Ph.D. — Department of Agronomy

TERM

July 1, 1971 to June 30, 1972

SPONSOR

Office of Water Resources Research, U.S. Department of the Interior, Project A-041-VA

FUNDING

Sponsor: \$7,500

OBJECTIVES

The first objective is to determine the effects of detergent polluted water on germination, growth, and corn position of corn; the chemical and physical properties of a fine and coarse textured soil; and the biological soil reactions. An additional objective is to characterize the movement of detergents and their chemical components through soil.

CONCLUSIONS

A greenhouse experiment was conducted in which corn (*Zea mays*) was grown on a Norfolk sandy loam and a Davidson clay loam soil and irrigated with distilled water which contained the following concentrations of an enzyme and non-enzyme household laundry detergent: 0; 20; 800; 1600; 4800; 8000; 10,000; 12,000; and 14,000 ppm. The soils were fertilized at the rate of 250 lbs. of N/A; 125 lbs. P₂O₅/A; and 125 lbs. K₂O/A and limed to establish an optimum pH for the growth of corn.

Notes were made of the dates of seedling emergence to determine if the two detergents on the different soils would speed up or delay seedling emergence; and pictures were made to record abnormal growth characteristics such as bending of stems, leaf constrictions, mottling, tip die back, chlorosis, necrosis, and leaf curling. It was found that seedling emergence was reduced up to 4 days on the Norfolk soil at 8,000 ppm of detergent and up to 4 days on the Davidson soil at 14,000 ppm of detergent.

At harvest, height and fresh weights were recorded. The plants were then oven dried and dry weights were recorded. From this physical data the conclusion was that injury was less severe on the Davidson soil than on the Norfolk soil, probably because of the higher clay content and increased surface area of the Davidson soil, thus giving it a higher adsorption capacity. Also, the non-enzyme detergent was more detrimental than the enzyme detergent. The reason for this is unknown at the present time.

RELEVANCE

Virginia, along with other states, is exploring the idea of spraying waste water effluents onto the land rather than discharging the water back into a surface stream. This method prevents the further deterioration of the surface water by point sources of pollution. The cost of this alternative appears to be economically attractive when compared with the cost of extensive treatment utilizing present technology for tertiary treatment. This study is looking at the long range effects of this method of waste water disposal as it affects the land for agricultural production. Preliminary indications suggest that detergents in waste water flow may cause high build-up of sodium, boron, and arsenic in the soil so as to destroy the land for agricultural production at a time when the demand for food may exceed the productive capacity of available agricultural lands.

TITLE

Chemical and Physical Reactions of Soils with Fly Ash of Importance to Its Agricultural Utilization

PROJECT DIRECTOR

David C. Martens, Ph.D. — Department of Agronomy

TERM

September 1, 1970 to August 31, 1973

SPONSOR

Bureau of Mines, U.S. Department of the Interior

FUNDING

Bureau of Mines: \$73,349; VPI&SU: \$5,670

OBJECTIVES

This research effort seeks to determine effects on plant growth of fly ash applications to soils of agricultural importance, to calculate and define chemical reactions of fly ash with soil, and to evaluate and define physical reactions of fly ash with soil.

CONCLUSIONS

Laboratory and greenhouse experiments were designed to determine if B, K, Mo, P, and Zn sorbed by plants was higher from fly ash-soil mixtures than from soil alone. Results of these studies indicated that application of selected fly ash samples increased the amount of each of the five nutrients sorbed by plants. Application of alkaline fly ash to an acid soil increased alfalfa growth by correction of molybdenum deficiency and by increasing soil pH. Increasing the pH of the soil alleviated toxicities associated with very low pH.

Application of acid fly ash to an alkaline soil corrected zinc deficiency of corn by supplying soluble Zn and by decreasing soil pH. The decrease in soil pH increased the availability of indigenous soil Zn. Results of the greenhouse studies indicated that application of selected fly ash samples to soil either completely or partially corrected the five nutrient deficiencies.

RELEVANCE

This research is designed to determine the amount of fly ash that can be disposed of in agricultural soils without adversely affecting plant growth and to evaluate beneficial effects on plant growth of fly ash disposal in agricultural soils.

PUBLICATIONS

Doran, J. W. (1969) The Availability of Soil Molybdenum as Affected by Fly Ash Applications and Certain Soil Properties; M.S. Thesis; Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

Martens, D. C., M. G. Schnappinger, Jr., J. W. Doran, and F. R. Mulford (1970) "Fly Ash as a Fertilizer"; Bureau of Mines Information Circular; No. 8488; pp. 310-326.

Martens, D. C., M. G. Schnappinger, Jr., and L. W. Zelazny (1970) "The Plant Availability of Potassium in Fly Ash"; Soil Science Society of America Proceedings; Vol. 34, No. 3; pp. 453-456.

Mulford, F. R. and D. C. Martens (1971) "Response of Alfalfa to Boron in Fly Ash"; Soil Science Society of America Proceedings; Vol. 35, No. 2; pp. 296-300.

Schnappinger, M. G., Jr. (1970) Zinc Deficiency Correction in Corn as Affected by Certain Properties of Four Virginia Soils and the Application of Zinc Sulfate, Zinc Chelates and Coal Ash; Ph.D. Thesis; Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

TITLE

Adapting the No-tillage System of Crop Production to Various Crops and Successions

PROJECT DIRECTOR

W. W. Moschler, M.S. — Department of Agronomy

TERM

April 17, 1968 to June 30, 1972

SPONSOR

Research Division of VPI&SU, Department of Agronomy

OBJECTIVES

Practical rotations, cropping sequences, and management practices that will expedite the adoption of no-tillage cropping systems by growers of corn, soybeans, and tobacco are being developed; and herbicides, liming, and fertilizer practices that will be amenable for no-tillage cropping are being evaluated.

CONCLUSIONS

Research is not yet complete.

RELEVANCE

No-tillage cropping was adopted by Virginia growers to represent over 100,000 acres in 1970. The acreage in 1972 may exceed 150,000 acres. It represents the most complete and thorough method of erosion control in row crops found to date; and since these have always been the major source of erosion and water loss in Virginia, the rapidly increasing use of no-tillage cropping would improve management practices. Exploratory research also indicates that fertilizer needed per unit of crop may be reduced. This would be doubly beneficial because the probability of the fertilizer nutrients reaching runoff or drainage waters would be reduced and phosphorus supplies would be conserved, rather than being lost as a pollutant to water.

PUBLICATIONS

Moschler, W. W., G. D. Jones, and G. M. Shear (1969) "Stand and Early Growth of Orchardgrass and Red Clover Seeded After No-tillage Corn"; Agronomy Journal; Vol. 61; pp. 475.

Moschler, W. W., G. M. Shear, D. C. Martens, G. D. Jones, and R. R. Wilmouth. "Comparative Yield and Fertilizer Efficiency of No-tillage and Conventionally Tilled Corn"; Agronomy Journal (In Press).

Shear, G. M., and W. W. Moschler (1969) "Continuous Corn by the Conventional and No-tillage Methods – A Six Year Comparison"; Agronomy Journal; Vol. 61; pp. 524-526.

TITLE

Suitability of Soils for Septic Tanks

PROJECT DIRECTOR

R. B. Reneau, Jr., Ph.D. – Department of Agronomy

TERM

July 1, 1971 to June 30, 1976

SPONSOR

Division of Local Health Services, State Department of Health

FUNDING

Sponsor: \$25,000

OBJECTIVES

The objectives of this project are to establish parameters considering the role of the physical, chemical, and morphological properties of soil on the dilution, assimilation, and filtration of organisms, nutrients, and surfactants with time and on the specific action of restricting layers and fluctuating water tables on effluent movement.

CONCLUSIONS

None at this time.

RELEVANCE

The investigation of septic tank effluent movement in the natural soil system is viewed as a fresh approach in the area of soil pollution. Although standards have been established for levels of air and water pollution, relatively little research has been directed towards levels of soil pollution and the complex, dynamic parameters of natural soils.

With the ever increasing efflux of the city dweller in Virginia to the suburban and rural areas, the numbers of families not served by public sewers increases annually. In these cases, domestic sewage disposal systems are employed. The increasing number of these systems is reflected by the fact that in 1969 there were 27,000 soil evaluations made for septic tank installations in Virginia.

The disposal of human and domestic wastes in these situations, without creating a nuisance and menace to health, is often difficult, if not impossible. Meeting these standards for a satisfactory disposal system becomes an even more difficult task because of the heterogenous nature of the media (soil). To accomplish this, the soil morphological, physical, and chemical properties must be established for the most prevalent soil types utilized for these systems. The behavior of pollutants in relation to these properties must be studied. Also, the ability of polluted soils to contaminate the ground water supply at some later time must be estimated. From these investigations, soil pollution criteria that consider the quality of the effluent entering the water table and watercourses are to be established. These criteria should then conform to established water quality standards.

TITLE

Invasion of the Aquatic Habitat by Amphibious Species of *Polygonum*

PROJECT DIRECTOR

Richard S. Mitchell, Ph.D. — Department of Biology

TERM

July 1, 1968 to June 30, 1970

SPONSOR

Office of Water Resources Research, U.S. Department of the Interior, Project A-028-VA

FUNDING

Sponsor: \$17,597

OBJECTIVES

The study sought to determine the aquatic capabilities of the American species of Smartweeds (*Polygonum*) and to rank them on their abilities for invasion of wetlands.

CONCLUSIONS

American *Polygonum* species were tested in submergence experiments under controlled growth chamber conditions and found to display a number of characteristics which allow survival of shoots when inundated. The most pronounced modifications were by *P. amphibium* which can change in appearance and physiology to accommodate to both aquatic and dry-land existence. Most of the other species, however, showed 100% survival of shoots inundated for over 30 days. These only had half the total survival capability of truly amphibious species, since they lost much vigor and productivity was down.

RELEVANCE

From this research much was learned about aquatic Smartweeds, some of which are capable of invading lakes and impoundments and seriously affecting their ecology. A guide was written for their identification and recommendations were made on the merits and shortcomings of different species for use in water management. Controlled environment experiments allowed species to be ranked on their abilities for invasion of wetlands.

PUBLICATIONS

Mitchell, Richard S. (1970) "A Re-evaluation of *Polygonum meisnerianum* in North America"; Rhodora; Vol. 72; pp. 182-188.

Mitchell, Richard S. (1971) "Invasion of the Aquatic Habitat by Amphibious Species of *Polygonum*"; Water Resources Research in Virginia — Annual

Report for Fiscal Year 1970; Bulletin 40, Water Resources Research Center; pp. 97-106.

Mitchell, Richard S. (1971) A Guide to Aquatic Smartweeds (*Polygonum*) of the United States; Bulletin 41; Water Resources Research Center; 57 p.

Mitchell, Richard S. (1971) "Comparative Leaf Structure of Aquatic *Polygonum* Species"; Amer. Jour. Bot.; Vol. 58; pp. 342-360.

TITLE

Limnological Investigations at Palmer Station Antarctica

PROJECT DIRECTOR

Bruce C. Parker, Ph.D. – Department of Biology

TERM

July 1, 1969 to December 1, 1971

SPONSOR

National Science Foundation

FUNDING

Sponsor: \$58,000

OBJECTIVES

The project included an ecological survey of freshwater habitats of coastal Antarctica, near Palmer Station, with emphasis on algal identification and nutrient requirements.

CONCLUSIONS

Some 100 species of algae were identified from the Palmer Station area, several new to Antarctica. A thorough survey of all parameters having possible roles as limiting factors on primary productivity indicated nutrient levels, particularly NH_4^+ and PO_4 concentrations, caused eutrophication of coastal lakes. Concentrations of NH_4^+ , largely from penguin guano, caused by far the greatest stimulation of primary producers in these coastal area waters.

RELEVANCE

For the first time an ecological investigation of this area was initiated especially regarding aquatic habitats. Results are relatable to temperate zone problems of water pollution. NH_4^+ as a limiting factor, more so than PO_4 , is of extreme importance in such functions as sewage waste treatment.

PUBLICATIONS

Parker, B. C. "The Container Effect on ^{14}C Primary Productivity Measurements"; J. Phycol.; 6 Suppl: 6.

-----, "Limnological Investigations in the Area of Anvers Island, Antarctica"; J. Phycol. 6 Suppl: 6.

-----, "Limnological Investigations of Algal Communities"; Antarctic J.; October 1970.

-----, "Limnological Investigations at Palmer Station"; Antarctic J.; July 1971.

-----, "A Comparative Study on Two Lakes of Different Trophic States"; Va. J. Sci.; (In Press).

-----, "Freshwater Algae of the Antarctic Peninsula. Preliminary Observations in the Palmer Station Area, Anvers Island"; Antarctic Folio Series; National Acad. Sci. (In Press).

-----, "Nutrient Factors Limiting Primary Productivity in Simulated Antarctic Microecosystems"; Bioscience; (In Press).

-----, Ed. Colloquium on Pollution and Conservation of the 7th Continent, Antarctica; Virginia Polytechnic Institute and State University, Blacksburg, Virginia (In Press).

TITLE

Aquatic Fungi of the Lotic Environment and Their Role in Stream Purification

PROJECT DIRECTOR

Robert A. Paterson, Ph.D. — Department of Biology

TERM

July 1, 1971 to June 30, 1972

SPONSOR

Office of Water Resources Research, U.S. Department of the Interior, Project A-043-VA

FUNDING

Sponsor: \$5,755

OBJECTIVES

The objectives of this project are to determine the aquatic fungal flora of the lotic environment; to determine the abundance of these fungi; to determine the changes that occur in the flora when effluents are introduced; and, using studies with selected fungi in the laboratory, to determine their possible role as purifiers of polluting effluents.

CONCLUSIONS

Collecting during the first quarter suggests the following trends: (1) only filamentous fungi have been found within the river; (2) there is a reduced diversity and abundance of aquatic fungi at the point where the effluent enters the river compared to collections made above and below this point; and (3) changes in the taxonomic composition of the fungal flora occur with time.

RELEVANCE

Bacteria and fungi utilize organic matter in streams as a source of food and, therefore, can reduce the amount of organic pollution. Bacteria have been the object of a number of studies, but the role of fungi in stream purification is poorly understood. Results of this investigation will broaden our understanding of the self-cleansing action of streams.

TITLE

Ecology and Distribution of Plankton Parasites and Aquatic Saprophytes in Lacustrine and Soil Habitats in Antarctica

PROJECT DIRECTOR

Robert A. Paterson, Ph.D. – Department of Biology

TERM

July 1, 1970 to June 30, 1972

SPONSOR

National Science Foundation

FUNDING

National Science Foundation: \$20,200; VPI&SU: \$7,305

OBJECTIVES

The research on aquatic fungi in the vicinity of McMurdo Station and the Dry Valleys, Antarctica, involves taxonomic and morphological studies of planktonic fungi and investigations of the vertical and horizontal distribution of fungal parasites of phytoplankton, the occurrence of benthic fungi, and the role of fungal parasites and saprophytes in the ecosystem.

CONCLUSIONS

In collections made from soil and water in the McMurdo Oasis of Antarctica, aquatic Phycomycetes occurred in 131 of the 171 samples. Algal parasites occurred in 57 collections. *Scherffeliomyces appendiculatus* was found in 3 collections and *Chytridium versatile* in 2 collections. Other parasites were found but have not been identified. Oomycetes occurred in 57 collections. *Pythium tenue* was isolated from 2 samples, and an asexual species of *Pythium* was isolated from 1 collection. Aside from unverified observations (no isolates were made) of *Aphanomyces* spp., members of the Saprolegniaceae were lacking. Saprophytic chytrids were represented by 4 species which occurred in 118 collections. Of these, 3 species were common over a broad range; they are, *Phlyctorhiza variabilis* and two new species. The reported keratinophilic nature of *P. variabilis* was reflected in its distribution which corresponded to the distribution of keratin-forming higher animals. *Rhizophlyctis rosea* was also found. It is thought to be a recent human introduction since it occurred in only 3 collections from areas disturbed by man. The diversity of species of aquatic Phycomycetes is low. This is probably due to the severe climatic stress on the organisms.

RELEVANCE

There is considerable concern by all countries that are signatories of the Antarctic Treaty about conservation of the continent. Studies such as this will contribute to our understanding of what organisms are present and what they do. Research of this type will help establish ecological "bench marks." This will make it possible to determine if any changes occur in the future and to determine what caused the changes — man or natural situations.

PUBLICATIONS

Paterson, R. A. and J. S. Knox (1971) "Aquatic Fungi; Their Occurrence on Ross Island and in the Dry Valleys"; Antarctic Jour. of the U.S.; Vol. 5, No. 4; p. 107.

Paterson, R. A. and J. S. Knox (1972) "The Occurrence of Aquatic Fungi in Victoria Land and Ross Island"; Proceedings of Colloquium on Conservation of Antarctica; (In Press).

TITLE

Toxicants and the EKG and Respiration of Fish

PROJECT DIRECTOR

John Cairns, Jr., Ph.D. — Department of Biology and Center for Env. Studies

TERM

June 1, 1969 to August 31, 1971

SPONSOR

Water Quality Office, Environmental Protection Agency

FUNDING

Water Quality Office: \$20,643; VPI&SU: \$3,570

OBJECTIVES

One of the most critical needs for industrial pollution control is a biological monitoring technique that can be associated with the effluent system and provide continual information feedback on quality. The purpose of this project was to develop a rapid means of assessing the non-lethal effects of toxicants upon fishes using changes in the electrocardiogram and breathing during exposure and to relate the "safe" or no response concentrations so estimated to longer term functions such as growth and reproductive success.

CONCLUSIONS

The lowest of a series of zinc concentrations tested was 2.55 mg/l. This concentration is well below the concentration that would kill 50% of the exposed fish in 96 hours (7.5 mg/l) in water of equivalent quality. The test fish detected concentration of 2.55 mg/l zinc after 52 hours. A zinc concentration of 4.16 mg/l was detected 11 hours after introduction. The results of reproduction experiments indicate that 1/10 of 2.55 mg/l zinc was not a safe concentration for chronic exposure, but that 1/100 of 2.55 mg/l zinc probably was safe.

RELEVANCE

Early symptoms of stress appear in the electrocardiograms and breathing records of fish exposed to potentially lethal concentrations of zinc. After further development, these biological monitoring techniques could be used in industrial plants to warn of accidental spills or environmental changes that produce acutely toxic conditions, in time to prevent damage to fish populations in streams.

PUBLICATIONS

Cairns, J., Jr., R. E. Sparks, and W. T. Waller (1971) "The Relationship between Continuous Biological Monitoring and Water Quality Standards for Chronic Exposure"; American Chemical Society, Division of Water, Air and Waste Chemistry, Preprints of papers presented at the 162nd National Meeting, Vol. 11, No. 2; pp. 55-62.

----- (1971) "The Relationship between Continuous Biological Monitoring and Water Quality Standards for Chronic Exposure"; Advances in Chemistry Series; American Chemical Society.

Sparks, R. E. (1971) Using the Respiratory Responses of Bluegill Sunfish (*Lepomis macrochirus* Rafinesque) to Monitor Zinc Concentrations in Water;

Ph.D. Thesis; Department of Biology; Virginia Polytechnic Institute and State University.

TITLE

A Systems Simulation of the Effects of Tertiary Treatment for Carbon, Nitrogen, and Phosphorus Removal upon Primary Productivity, Standing Crop, and Community Structure of Autotrophic and Heterotrophic Communities in Receiving Model Streams

PROJECT DIRECTORS

John Cairns, Jr., Ph.D. — Department of Biology and Center for Env. Studies
Kenneth L. Dickson, Ph.D. — Dept. of Biology and Center for Env. Studies
Paul King, Ph.D. — Department of Civil Engineering
Clifford Randall, Ph.D. — Department of Civil Engineering

TERM

July 1, 1971 to June 30, 1973

SPONSOR

Office of Water Resources Research, U.S. Department of the Interior, Project B-039-VA

FUNDING

Office of Water Resources Research: \$22,120.00; VPI&SU: \$26,495.25.

OBJECTIVES

The effects of enrichment upon six model laboratory streams will be studied over a period of 18 months, approximately. Sources of enrichment are from domestic sewage subjected to tertiary treatment (Civil Engineering Dept.) for removal of C, N, and P. The structure and function of the autotrophic (periphyton) community within each stream will be studied and subjected to various dilutions and combinations of introduced enrichment. Primary productivity, algal biomass, chlorophyll content, dissolved solids, and other chemical and physical variables are to be monitored.

CONCLUSIONS

At present, the laboratory model streams are almost completely constructed. A large photoperiod room to house the streams is approximately two-thirds completed. Periphyton communities from a nearby stream have been recently collected and are acclimating in the laboratory.

RELEVANCE

This project will help determine the adequacy of tertiary treatment for

removal of algal nutrients. Additional data on the roles of carbon, nitrogen, and phosphorus in the eutrophication process will be procured. Understanding the response of aquatic communities to nutrient enrichment will be valuable in the management of reservoirs and should influence management decisions regarding recreational uses, fisheries, and quality of water supply.

This is one of the few water pollution studies to use model laboratory streams, a very useful research tool. An interdisciplinary approach between the Sanitary Engineering group and the Biology Department is utilized, one of the few times this has occurred.

TITLE

The Study of Biological Effects of Spill from Clinch River Plant

PROJECT DIRECTOR

John Cairns, Jr., Ph.D. — Department of Biology and Center for Env. Studies

TERM

July 1, 1969 to July 1, 1972

SPONSOR

American Electric Power Corporation

FUNDING

Sponsor: \$41,032.50

OBJECTIVES

This research was undertaken to determine the extent of the biological damage of a fly-ash pond spill at the Appalachian Power Plant at Carbo, Virginia.

CONCLUSIONS

On June 10, 1967, the dike surrounding a fly-ash settling pond collapsed at Appalachian Power Company's steam power plant near Carbo, W. Va. In less than an hour 400 acre-feet of alkaline water entered the Clinch River. For approximately ninety miles below the spill site populations of aquatic organisms were severely damaged. Beginning July 1, 1969, 21 sampling stations were located on the Clinch and related tributaries, and bottom fauna samples were collected using bottom nets and Surber samplers. Fish were also seined at six stations. The bottom fauna samples showed recovery of the invertebrate populations as analyzed by the Sequential Comparison Index. However, mollusc species that were found above the spill site were absent below. Further examinations also showed a difference in the density of the organisms above the spill site to those below. These results indicate recovery

of the river from the effects of the spill but not full recovery (Research supported by the Appalachian Power Company).

RELEVANCE

The purpose for studying industrial spills is to understand how aquatic ecosystems are affected and how they can be restored.

PUBLICATIONS

(*Indicates paper presented, abstract only.)

Cairns, John Jr., John S. Crossman, and Kenneth L. Dickson (1970) "The Biological Recovery of the Clinch River Following a Fly-ash Pond Spill"; Purdue Engineering Bulletin (Invited Paper).

Cairns, J. Jr., John S. Crossman, and K. L. Dickson (Invited Chap.) "The Response of Aquatic Communities to Spills of Hazardous Materials"; Proc. Symposium on Hazardous Materials.

Cairns, John Jr., John S. Crossman, Kenneth L. Dickson, and Edwin E. Herricks (1971) "The Effects of Major Industrial Spills Upon Stream Organisms"; Purdue Engineering Bulletin (Invited Paper).

Cairns, John Jr., John S. Crossman, Kenneth L. Dickson, and Edwin E. Herricks (1971) "The Recovery of Damaged Streams"; Assoc. Southeastern Biol. Bull.; 18 (3).

Crossman, John S. and John Cairns, Jr. "A Comparison of Two Macroinvertebrate Samplers and Regular Stream Sampling Techniques"; Assoc. Southeastern Biol. Bull. (In Press).

Crossman, John S., John Cairns, Jr., and Kenneth L. Dickson (1970) "The Biological Recovery of the Clinch River Following a Fly-ash Spill"; Assoc. Southeastern Biol. Bull. *; 17 (2); p. 39.

Crossman, John S., Jerry C. Smrcek, and John Cairns, Jr. "A Preliminary Study of the Pelecypoda in the Upper Clinch River"; Assoc. Southeastern Biol. Bull. (In Press).

TITLE

Studies on the Biological, Chemical, and Physical Water Quality of the New River Related to Appalachian Power Company's Blue Ridge Project

PROJECT DIRECTORS

John Cairns, Jr., Ph.D. — Department of Biology and Center for Env. Studies

Kenneth L. Dickson, Ph.D. — Dept. of Biology and Center for Env. Studies
Albert C. Hendricks, Ph.D. — Center for Environmental Studies
Ernest F. Benfield, Ph.D. — Department of Biology
Robert D. Ross, Ph.D. — Department of Biology

TERM

July 1, 1970 to August 1972

SPONSOR

Appalachian Power Company

FUNDING

Sponsor: \$86,000

OBJECTIVES

The objectives are, first, to conduct a biological survey of the New River and associated tributaries above, in, and below the proposed site of the Blue Ridge Project before construction begins, so that a baseline of information is established for future comparison; and, second, to monitor physical and chemical water quality at selected sampling stations within the survey area.

CONCLUSIONS

During the first year of this two year study, macroinvertebrates were collected at two different time periods from 20 sampling stations, strategically selected to include major tributaries and industrial outfalls as well as "unaffected" segments of the main stem of the New River in North Carolina, Virginia, and West Virginia. In addition, fish collections were made at several points within the study area. While the biological data has not yet been fully collated and diversity indices applied, a cursory examination of the information indicates a relatively diverse and unstressed biota within the area of the proposed Blue Ridge reservoirs.

Physical and chemical water quality parameters were monitored on a bi-weekly basis at nine stations, for the first year of the study. They are being continued on a monthly schedule. Parameters being checked include such things as temperature, specific conductivity, turbidity, total and dissolved solids, pH, phosphates, nitrates, BOD, heavy metals, and various other ionic species. General fluctuations and sources of unusually high nutrient and heavy metal input are being noted. With the addition of the second year's physical and chemical data, the occurrence of cyclic changes should become apparent. Further studies will attempt to clarify their importance.

RELEVANCE

The results of this research will provide a rather broad baseline, reflecting the present status of the biological, chemical, and physical nature of the New

River above, within, and below the proposed Blue Ridge Project reservoirs.

With the data obtained it will be possible to identify input sources that may produce problems after impoundment of the river. It will also be possible to assess any environmental changes downstream due to the activity of the project. By the early identification of potential problem sources, it may be possible to rectify them.

TITLE

The Application of Biological Monitoring Systems to Simulated Industrial Waste Discharge Situations

PROJECT DIRECTOR

John Cairns, Jr., Ph.D. — Department of Biology and Center for Env. Studies

TERM

July 1, 1971 to June 30, 1972

SPONSOR

Office of Water Resources Research, U.S. Department of the Interior, Project A-039-VA

FUNDING

Sponsor: \$5,000

OBJECTIVES

The purpose of this research is to apply two biological monitoring systems already developed in our laboratory to the complex situation that might exist at an industrial site where zinc is a pollution problem.

CONCLUSIONS

The research is still in progress and the findings are not complete.

RELEVANCE

Because industrial waste characteristics and stream characteristics vary and interact, it would be difficult, if not impossible, to predict the toxicity to aquatic life of zinc or other materials at an industrial site from physical-chemical data alone. Fish respond to the collective effects of many environmental factors and, thus, would be good biological sensors. In addition, since water quality standards are designed to protect aquatic organisms, the direct monitoring of the responses of representative organisms, such as fish, seems reasonable. The purpose of this research is to demonstrate that already-developed biological monitoring techniques, which use the responses of fish, can be used at industrial sites to prevent damage to fish populations in streams.

TITLE

The Recovery Rate of Aquatic Communities of Streams Receiving Acid Mine Drainage

PROJECT DIRECTOR

John Cairns, Jr., Ph.D. — Department of Biology and Center for Env. Studies

TERM

July 1, 1970 to June 30, 1973

SPONSOR

Office of Water Resources Research, U.S. Department of the Interior, Project B-034-VA

FUNDING

Office of Water Resources Research: \$19,240; VPI&SU: \$19,247

OBJECTIVES

Work on this project will outline and identify the processes involved in the recovery of aquatic communities after a prolonged stress. If the stress is removed the recovery rate of the communities will be studied to note the speed with which a viable community is again established.

CONCLUSIONS

Studies of the effects of acute and chronic stress conditions on stream macrobenthic communities were made. The response of a healthy stream fauna to an acute pH stress which left no residual toxicity was an immediate reduction in community structure analysis \bar{d} and density. The \bar{d} values and density rose to pre-stress levels by Day 28 and oscillated around a mean value. The mechanism of restoration was probably the downstream drift of invertebrate species which recolonized the damaged area.

The effects of a chronic stress were studied in streams receiving acid mine discharges. The effect of an isolated discharge on a healthy stream is a drop in pH and an increase of total acidity and a decrease in total alkalinity. The stream fauna is also reduced with \bar{d} values falling below 2.0 (pollution indication) and densities of 10 organisms 1 ft². Recovery is related to the entrance of healthy unpolluted tributaries. These tributaries have the dual function of improving water quality and supplying organisms for recolonization of damaged sections of the stream. When water quality is improved by neutralization of acidic waters, restoration of a healthy stream fauna is still related to the effects of tributaries as sources of recolonizing organisms.

RELEVANCE

Acid mine drainage presently affects 48,000 miles of streams and 29,000

surface acres of reservoirs and impoundments in the United States. To date, most states where mining operations have been or are proceeding have legislated strong standards concerning mine discharges. At present very little is known concerning the recovery processes involved in restoration of damaged aquatic communities. Very little is known about the speed of recovery. It is the intent of this work to discover information to answer questions in both of these areas as they relate to acid mine drainage.

PUBLICATIONS

Cairns, J. Jr., J. S. Crossman, K. L. Dickson, and E. E. Herricks (1971) "The Recovery of Damaged Streams"; ASB Bulletin; Vol. 18, No. 3; pp. 79-106.

Cairns, J. Jr., J. S. Crossman, K. L. Dickson, and E. E. Herricks "The Effects of Major Industrial Spills upon Stream Organisms"; Purdue Engineering Bulletin (In Press).

TITLE

Effects of Toxicants on Fish Movement Patterns

PROJECT DIRECTOR

John Cairns, Jr., Ph.D. — Department of Biology and Center for Env. Studies

TERM

June 1, 1969 to August 31, 1971

SPONSOR

Water Quality Office, Environmental Protection Agency

FUNDING

Sponsor: Approx. \$16,000

OBJECTIVES

The purpose of this research was to develop a rapid means of assessing non-lethal effects of toxicants upon fishes, using changes in movement patterns during exposure to toxicants, and to relate the "safe" or no response concentrations so estimated to longer term functions such as growth and reproductive success. Light beam interruption was the technique used to measure the movement pattern of the test species.

CONCLUSIONS

Potentially lethal concentrations of zinc (7.5 mg/l) can be detected rapidly enough by monitoring the movement patterns of fish, so that the fish survive if the zinc is removed at the time of detection. The lowest concentration of zinc detectable by monitoring fish movement during a 96 hour exposure lies

between 3.64 and 2.94 mg/l. A zinc concentration of .250 mg/l in dechlorinated Blacksburg municipal water is not safe for long term exposure of bluegill sunfish, while a concentration of .025 appears to be safe.

RELEVANCE

The technique for monitoring the movement of fish should be useful in the prevention of accidental spills or environmental changes that produce acutely toxic conditions. The experiments with zinc show that detection occurs soon enough for fish to recover if zinc addition is promptly stopped at the time of detection.

PUBLICATIONS

Cairns, J., Jr., R. E. Sparks, and W. T. Waller (1971) "The Relationship between Continuous Biological Monitoring and Water Quality Standards for Chronic Exposure"; American Chemical Society, Division of Water, Air and Waste Chemistry, Preprints of papers presented at the 162nd National Meeting; Vol. 11, No. 2; pp. 55-62.

----- (1971) "The Relationship between Continuous Biological Monitoring and Water Quality Standards for Chronic Exposure"; Advances in Chemistry Series; American Chemical Society.

Waller, E. T. (1971) The Use of Fish Movement Patterns to Monitor Zinc in Water; Ph.D. Thesis; Department of Biology, Virginia Polytechnic Institute and State University.

TITLE

An Ecological Investigation of the New River in the Vicinity of the Celanese Corporation, Pearisburg, Virginia

PROJECT DIRECTORS

John Cairns, Jr., Ph.D. — Department of Biology and Center for Env. Studies
Kenneth L. Dickson, Ph.D. — Dept. of Biology and Center for Env. Studies
Albert C. Hendricks, Ph.D. — Center for Environmental Studies
Robert D. Ross, Ph.D. — Biology Department

TERM

June 1971 to June 1973

SPONSOR

Celanese Corporation of America

FUNDING

Sponsor: \$23,857.60

OBJECTIVES

The objectives of the study are to establish an instream monitoring system of the Celanese Corporations's industrial discharges, including investigations of fishes, benthic organisms, primary productivity, and water quality and to determine seasonal trends of these biological parameters in the New River within the study area.

CONCLUSIONS

The findings are not yet available.

RELEVANCE

The investigators' intentions are to monitor, identify, define, and interpret the effects on the aquatic environment of water quality changes in the New River resulting from the Celanese Corporation's industrial discharges. Information obtained will support defense of alleged damages or provide a basis for corrective measurements if damages do occur.

TITLE

An Evaluation of Present and Future Eutrophication in Smith Mountain Lake, Virginia

PROJECT DIRECTORS

A. C. Hendricks, Ph.D. — Center for Environmental Studies
E. F. Benfield, Ph.D. — Department of Biology
E. R. Stout, Ph.D. — Department of Biology

TERM

June 1, 1971 to September 1, 1971

SPONSOR

Appalachian Power Company

FUNDING

Sponsor: \$5,290

OBJECTIVES

Using ^{14}C assimilation rates, chlorophyll-a measurements, and phytoplankton community structures as criteria, the present degree of degradation in water quality in the lake will be assessed.

CONCLUSIONS

Conclusions are not ready for publication at this time.

RELEVANCE

It is increasingly difficult to find a river in the United States which does not have from one to several dam sites constructed somewhere along its course. The impounded water, in many cases, is used in a variety of ways including power generation, recreation, and public water supply.

In many instances, the impounded water receives effluents from municipal, industrial, and agricultural waste discharges which often cause serious problems in water quality. Should water quality in an impoundment become deteriorated to a point such that the water is condemned by governmental control authorities for certain types of use, a great natural resource is lost.

Research projects such as the Smith Mountain Lake project provide information relating the response of the impoundment to water quality damaging effluents. Such research not only provides information relating to the impoundment in question, but often provides information that may be useful in determining responses of other impoundments to water quality perturbing influences. This information could be useful in site selection for new projects which are planned for municipal-industrial areas.

TITLE

Biological Survey of the Bottom Fauna of Peter's Creek in the Vicinity of the Roanoke Electric Steel Plant, Plus the Chemical Characterization of the Aqueous Wastes from the Plant

PROJECT DIRECTORS

Albert C. Hendricks, Ph.D. — Center for Environmental Studies
Robert C. Hoehn, Ph.D. — Department of Civil Engineering

TERM

April 1, 1971 to March 31, 1972

SPONSOR

Roanoke Electric Steel Corporation

FUNDING

Sponsor: \$12,475

OBJECTIVES

The purpose of this survey is to determine the biological condition of Peter's Creek above and below discharge of Roanoke Electric Steel. Using aquatic macroinvertebrates as the basis for estimating the biological conditions, a comprehensive study of the water chemistry and temperature of Peter's Creek and the effluent from Roanoke Electric Steel is being made.

CONCLUSIONS

The summer studies indicated that the thermal discharges by Roanoke Electric Steel were having little or no effect upon the temperature regime of Peter's Creek. It was found, however, that a certain amount of oil was being absorbed by particles in the cooling water and when these particles reached the creek, they were settling out. These, we feel, are having an adverse effect upon the bottom fauna.

RELEVANCE

The significance of this research may be summarized in three statements. (1) It determined that Roanoke Electric Steel was not exceeding the temperature limits of the stream. (2) It showed that the industry is adding a pollutant that is having an adverse effect upon the stream. (3) The research demonstrates the fact that only biological sampling could point out the degradation of water quality by the oil.

TITLE

Adsorption of Organic Compounds onto Solids from Aqueous Solutions

PROJECT DIRECTOR

J. P. Wightman, Ph.D. — Department of Chemistry

TERM

July 1, 1968 to July 1, 1970

SPONSOR

Office of Water Resources Research, U.S. Department of the Interior, Project A-026-VA

FUNDING

Sponsor: \$19,755

OBJECTIVES

The amount of phenol adsorbed from aqueous solutions on silica, carbon, nylon, polyethylene, and Teflon over a wide range of phenol concentration was measured; and the solids were characterized by surface areas, infrared spectra, and contact angles.

CONCLUSIONS

The surface areas of Cab-O-Sil, Graphon, Aviamide, Alathon, Microthene, and Teflon were 223, 87, 1.5, 0.10, 0.35, and 8.5 m²/gm, respectively, measured by either low temperature nitrogen or krypton adsorption. The critical surface tensions of Microthene, Alathon, and Teflon were 35, 31.5, and 28 dynes/cm, respectively. The value for Teflon was anomalously high. The

contact angles of phenol solutions against Microthene and Alathon were invariably higher for Alathon consistent with the critical surface tensions above. The multiple internal reflection infrared spectrum of Microthene showed more adsorption bands than Alathon consistent with the contact angles above. The amount (in grams) of phenol adsorbed on a unit weight basis was 6×10^{-2} , 3×10^{-2} , 7×10^{-3} , 8×10^{-4} , 6×10^{-4} , and 5×10^{-4} on Aviamide, Graphon, Cab-O-Sil, Microthene, Alathon, and Teflon, respectively, at a reduced concentration of 0.1. The results for Teflon are at best marginal due to the extremely small quantity of phenol absorbed. No significant temperature dependence was noted in the adsorption of phenol or carbon. The amount (in grams) of phenol adsorbed on a unit area basis was 4×10^{-1} , 8×10^{-3} , 2×10^{-3} , 3×10^{-4} , and 3×10^{-5} on Aviamide, Alathon, Microthene, Graphon, and Cab-O-Sil, respectively, at a reduced concentration of 0.1. The interaction of phenol with Aviamide appears to involve a sorption process as contrasted to adsorption — a surface phenomenon. The amount of phenol absorbed per unit area by the solid increases as the surface energy of the solid decreases.

RELEVANCE

The compound phenol is a common water pollutant and is quite toxic. There have been only a limited number of solids used to remove pollutants in water treatment. This work indicates that other solids, particularly nylon, may be quite effective in removing phenol and/or other pollutants. This is of particular interest since polymers, which are a part of our solid waste disposal problem, could rather be used as solids in water treatment.

PUBLICATIONS

Wightman, J. P., L. R. Dole, J. Jones, and C. A. King (1971) Adsorption of Organic Compounds onto Solids from Aqueous Solutions; Bulletin 42, Water Resources Research Center, Virginia Polytechnic Institute and State University.

TITLE

The Effect of Detergents on Gas Absorption Processes

PROJECT DIRECTOR

Jerry A. Caskey, Ph.D. — Department of Chemical Engineering

TERM

July 1, 1968 to June 30, 1970

SPONSOR

Office of Water Resources Research, U.S. Department of the Interior, Project A-025-VA

FUNDING

Sponsor: \$11,870

OBJECTIVES

Detergents lower the efficiency of secondary waste treatment plants by reducing oxygenation rates. This project investigated several different types of surfactant molecules and discussed their effects on oxygenation.

CONCLUSIONS

A quiescent-state absorption apparatus was used with carbon dioxide and water as the absorption system. Six surfactants were selected for study, namely, n-octanol, lauryl diglycol amide, lauryl diethanol amide, sodium lauryl sulfate, and sodium lauryl benzene sulfonate.

Preliminary absorption tests were made using pure deionized water to determine the diffusion coefficient for the system. A value of $1.93 \pm 0.05 \times 10^5$ square centimeters per second was obtained. The absorption tests were repeated with the six surfactant solutions at different concentrations. Then the interfacial resistance for each solution was calculated.

The octanol with the hydroxyl group at a branched position was found to cause a higher interfacial resistance than those with hydroxyl groups at the end of the hydrophobic chain. It was also concluded that increasing the molecular weight of the hydrophilic group decreased the interfacial resistance.

RELEVANCE

During recent years there has been an increasing public awareness of the effect of detergents on our waters. Such phenomena as foaming and biodegradability have become well-known topics of concern. Each of these problems has been dealt with by tailoring the detergent molecule.

Detergents lower the efficiency of secondary waste treatment plants by reducing oxygenation rates. The above project showed that different commercial detergent molecules can affect the oxygenation rate by as much as $\pm 20\%$.

PUBLICATIONS

Caskey, J. A., R. F. Herbert, and Y. P. To (1971) The Effect of Detergents on Gas Absorption Processes; Bulletin 35; Water Resources Research Center, Virginia Polytechnic Institute and State University.

Herbert, R. F. (1970) The Effect of Surfactant Hydrophilic Functional Groups on Gas Absorption Rates; M.S. Thesis; Department of Chemical Engineering; Virginia Polytechnic Institute and State University.

To, Y. P. (1970) The Effect of the Positions and Molecular Weight of Hydrophilic Functional Groups of Surfactants on Gas Absorption Rates; M.S. Thesis; Department of Chemical Engineering; Virginia Polytechnic Institute and State University.

TITLE

Electrochemical Activation and Regeneration of Carbon Surfaces for Tertiary Water Treatment

PROJECT DIRECTOR

George B. Wills, Ph.D. — Department of Chemical Engineering

TERM

July 1, 1969 to July 1, 1971

SPONSOR

Office of Water Resources Research, U.S. Department of the Interior, Project A-032-VA

FUNDING

Office of Water Resources Research: \$15,000; VPI&SU: \$4,000

OBJECTIVES

In this study an electrochemical carbon activation process was investigated which may have important advantages in tertiary water treatment processes using activated carbon.

CONCLUSIONS

It is concluded that the absorptive capacity of wetted carbon surfaces can be greatly increased by anodically oxidizing a 20% hydrochloric acid solution to involve chlorine at the surface to be activated.

The persistent pesticide Dieldrin is not only absorbed on the wetted carbon surfaces, but also penetrates into the carbon structure, and, in fact, most of the absorptive capacity of the carbon is due to this penetration of the pesticide into the carbon structure.

Spent carbon surfaces can be reactivated by anodic oxidation in 20% hydrochloric acid, but surfaces so activated have an absorptive capacity only about 10% greater than that of the original surface.

RELEVANCE

A novel process for treating water to remove persistent pesticides was demonstrated.

PUBLICATIONS

Wilson, L. D. (1970) Electrolytic Activation of Carbon; M.S. Thesis; Department of Chemical Engineering, Virginia Polytechnic Institute and State University.

TITLE

Economic Disposal of Waste Sludges from Water Treatment Plants

PROJECT DIRECTOR

Paul H. King, Ph.D. — Department of Civil Engineering

TERM

July 1969 to June 1971

SPONSOR

Office of Water Resources Research, U.S. Department of the Interior, Project A-030-VA

FUNDING

Sponsor: \$14,200

OBJECTIVES

The objectives were to study the economics of possible methods for concentration, dewatering, and ultimate disposal of water treatment plant sludges resulting from conventional processes; to investigate the use of polymers for sludge conditioning; and to evaluate the suitability of the dried product for ultimate disposal as landfill.

CONCLUSIONS

Polyelectrolytes, particularly anionic polymers, were found to be highly effective conditioning agents for alum and ferric sulfate and lime sludges leading to rapid release of gravity drainage water and improved performance in vacuum filtration. The mechanism responsible for the conditioning process was determined to be chemical bridging. Polymer sorption was rapid, and extended periods of flocculation following polymer addition were detrimental to system performance. System pH and solids concentration also affected the polymer conditioning process. Alum sludges were shown to remain stable in lagoons, and dewaterability was not enhanced unless natural freezing and thawing occurred.

RELEVANCE

Efforts toward water quality enhancement have been generally very beneficial to the water utility industry. However, these efforts have led to concern over waste discharges which previously received little attention. A good example is

wastes from water treatment plants which heretofore have been discharged to the nearest watercourse with little or no treatment. This research has explored possible methods for treatment of such wastes and has resulted in a definition of appropriate procedures for a variety of operating conditions.

PUBLICATIONS

Argo, D. G. (1971) Polyelectrolyte Conditioning of Lime Sludges; M.S. Thesis; Department of Civil Engineering, Virginia Polytechnic Institute and State University.

Bugg, H. M. (1970) Conditioning and Disposal of Water Treatment Plant Sludges; Ph.D. Dissertation; Department of Civil Engineering, Virginia Polytechnic Institute and State University.

Bugg, H. M., P. H. King, and C. W. Randall (1970) "Polyelectrolyte Conditioning of Alum Sludge"; Journal of the American Water Works Assoc.; Vol. 62; pp. 792-795.

King, P. H., W. S. Medding, and C. W. Randall (1970) "Lagoon Disposal of Water Treatment Plant Wastes"; Jour. of the Sanitary Engineering Div., Amer. Soc. of Civil Engineers; Vol. 96; pp. 1031-1033.

King, P. H., J. W. Olver, C. W. Randall, and J. A. Caskey (1971) "Conditioning and Disposal of Ferric Sulfate Sludges"; Proceedings of the Annual North East Regional Antipollution Conference; Vol. 4 (In Press).

Medding, W. S. (1969) Lagoon Disposal of Water Treatment Plant Sludges; M.S. Thesis; Department of Civil Engineering; Virginia Polytechnic Institute and State University.

Olver, J. W. (1970) Conditioning of Ferric Sulfate Sludges; M.S. Thesis; Department of Civil Engineering, Virginia Polytechnic Institute and State University.

TITLE

The Effect of Reservoir Operating Policy on Recreation Benefits

PROJECT DIRECTOR

Paul H. King, Ph.D. — Department of Civil Engineering

TERM

July 1969 to December 1971

SPONSOR

Office of Water Resources Research, U.S. Department of the Interior, Project B-009-VA

FUNDING

Office of Water Resources Research: \$14,000; VPI&SU: \$14,000

OBJECTIVES

Qualitative and quantitative guidelines for evaluating the effect of reservoir drawdowns on the recreational use of impounded water were developed. The effect of selected operating policies and assumed benefit-loss functions for recreation on the optimal operating procedure of a multi-reservoir water resource system was evaluated.

CONCLUSIONS

Data concerning recreational visitation and reservoir operation for numerous projects were collected and analyzed. Results indicated that physical crowding at recreational sites was a factor of more importance than operating policy in determining the recreation potential of an impoundment. Since no statistically significant relationship between drawdown and recreational visitation could be isolated, it was concluded that usually accepted values of a visitor day were a better estimator of minimum rather than maximum per capita benefit. The effect of varying the value of a visitor day of recreation from \$0.00 to \$5.00 on the optimal operation of a multi-reservoir system was evaluated using a deterministic dynamic programming algorithm.

RELEVANCE

The results of this study suggest that water management agencies have frequently been overly restrictive in placing absolute limits on reservoir drawdowns and that in many situations recreational attendance and concurrent benefits are more closely related to other factors. Optimal reservoir operating schedules were, however, shown to be quite sensitive to the value of recreation.

PUBLICATIONS

Morgan, J. M. and P. H. King. "Effects of Reservoir Operating Policy on Recreation Benefits"; Water Resources Bulletin: Jour. of the Amer. Water Resources Assoc.; Vol. 7; pp. 765-773.

TITLE

Microbial Release of Soluble Phosphate in an Activated Sludge Environment

PROJECT DIRECTOR

Clifford W. Randall, Ph.D. — Department of Civil Engineering

TERM

July 1, 1968 to June 30, 1970

SPONSOR

Office of Water Resources Research, U.S. Department of the Interior, Project A-024-VA

FUNDING

Sponsor: \$14,995

OBJECTIVES

The goal of this research was to define the major mechanisms of activated sludge phosphate release and to investigate ways that phosphorus desorption could be controlled or prevented during waste treatment.

CONCLUSIONS

Activated sludge phosphate release is a biological phenomenon. It is the result of biological stress and is relatively independent of chemical factors such as pH and ORP over the normal range of activated sludge operation. The rate of release nearly always corresponds to the expected death rate of the microorganisms. Anoxic release is much greater than aerobic release. Such release can be controlled by proper selection of aeration period and rate, dissolved oxygen level, food-to-microorganism level, and chemical addition.

RELEVANCE

The results of this research can be used to modify activated sludge waste treatment operation for optimum phosphorus removal. The amount of phosphorus removed by conventional operation can be considerably increased by slight modification and a small increase in operating costs.

PUBLICATIONS

Hulcher, B. S. (1970) Operational and Environmental Factors Affecting Activated Sludge Phosphate Release; Ph.D. Dissertation, Department of Civil Engineering, Virginia Polytechnic Institute and State University.

Hulcher, B. S., C. W. Randall, and P. H. King. "The Mechanism of Activated Sludge Phosphate Release and Methods of Control"; Proceedings, 26th Annual Purdue Industrial Waste Conference, Purdue University, May 1971 (In Press).

Marshall, D.W. (1968) The Relation of ORP to Orthophosphate Release by Activated Sludge; Master's Thesis; Department of Civil Engineering, Virginia Polytechnic Institute and State University.

Randall, C. W. "Microbial Release of Soluble Phosphate in an Activated Sludge Environment"; Proceedings, Summer Institute on Environmental Quality: Now or Never, Society of Industrial Microbiologist, Michigan State University, June 1970 (In Press).

Randall, C. W., B. S. Hulcher, and P. H. King. "Factors that Affect Activated Sludge Phosphate Release"; Water Resources Bulletin, Jour. of the Amer. Water Resources Assoc. (In Press).

Randall, C. W., B. S. Hulcher, and D. W. Marshall (1971) Microbial Release of Soluble Phosphate in an Activated Sludge Environment; Bulletin 36; Water Resources Research Center, Virginia Polytechnic Institute and State University.

Randall, C. W., D. W. Marshall, and P. H. King (1969) "Phosphate Release in the Activated Sludge Process"; Abstract; Proceedings of the 2nd National Symposium on Sanitary Engineering Research, Development, and Design, ASCE, Cornell University; pp. 51-54.

Randall, C. W., D. W. Marshall, and P. H. King (1970) "Phosphate Release in Activated Sludge Process"; Jour., Sanitary Engineering Div. ASCE; Vol. 96; p. 395.

TITLE

The Utilization of Filamentous Microorganisms for Biological Waste Treatment Purposes

PROJECT DIRECTOR

Clifford W. Randall, Ph.D. – Department of Civil Engineering

TERM

September 1968 –

OBJECTIVES

This project explores the adaptability of filamentous microorganisms to various environmental conditions and evaluates the efficiency of such microbial systems for waste treatment purposes.

CONCLUSIONS

Filamentous microorganisms, when grown in a vertical screen activated sludge type environment, can stabilize organic waste very efficiently. The treated effluent is generally superior in quality to conventional activated sludge effluent. The filamentous organisms are not easily upset by environmental change and can effectively remove soluble organics at a pH as low as 2.65.

Below 2.65 efficiency is poor. The filamentous system does not require as much nitrogen as typical sludge and can efficiently treat a waste normally considered to be nutrient deficient. Sludge production and oxygen requirements are similar to that of activated sludge.

RELEVANCE

This research has demonstrated that low pH wastes and wastes normally considered to be nutrient deficient can be treated with chemical adjustment or addition. The process developed is as economical as conventional activated sludge, but is considerably more reliable.

PUBLICATIONS

Albert, R. C. (1971) Treatment of a Mixed Organic Waste Utilizing Attached Filamentous Microorganisms; M.S. Thesis; Department of Civil Engineering, Virginia Polytechnic Institute and State University.

Edwards, H. R. (1970) The Development of Process Kinetics for a Waste Treatment System Utilizing Filamentous Microorganisms; Ph.D. Thesis; Department of Civil Engineering, Virginia Polytechnic Institute and State University.

Randall, C. W., H. R. Edwards, and P. H. King (1970) "A Filamentous Microbial Process for the Treatment of Nitrogen Deficient and Low pH Wastes"; Journal Water Pollution Control Federation (In Press).

TITLE

Optimal Conditioning Procedures for Waste Activated Sludge Disposal

PROJECT DIRECTOR

Clifford W. Randall, Ph.D. — Department of Civil Engineering

TERM

July 1, 1970 to June 30, 1972

SPONSOR

Office of Water Resources Research, U.S. Department of the Interior, Project A-035-VA

FUNDING

Sponsor: \$15,390

OBJECTIVES

This project evaluates and develops procedures for handling and dewatering waste activated sludge with particular emphasis on the effect of various

handling procedures on the subsequent filterability of waste activated sludge and the amount of polyelectrolyte needed for conditioning purposes.

CONCLUSIONS

Studies have shown that the handling methods used to process waste activated sludge have a very important effect on the subsequent dewatering of the sludge. Any condition such as anaerobiosis, chlorination, extreme temperature, or excessive pH, that detrimentally affects microbial metabolism, will cause a worsening of dewatering properties. Conditions that promote microbial metabolism and floc formation, such as aerobic digestion, improve dewatering properties as long as the organisms remain viable. However, excessive aerobic digestion, in excess of 6 days, will result in a deterioration of sludge flocs and poor dewatering. Excessive mixing under any conditions will worsen dewatering.

RELEVANCE

This research has shown that many of the techniques used during the processing of waste activated sludge actually make the sludge more difficult and, thus, disposal more expensive. Proper handling will simplify dewatering and result in smaller required chemical conditioning dosages. This study outlines the handling procedures that should be followed.

PUBLICATIONS

Parker, D. G. (1970) Factors Affecting the Filtration Characteristics of Aerobically Digested Sludge; Ph.D. Thesis; Department of Civil Engineering, Virginia Polytechnic Institute and State University.

Parker, D. G., C. W. Randall, and P. H. King (1971) "Activated Sludge Dewatering: Biological Conditioning for Improved Filterability"; Abstract; 44th Annual Conference, Water Pollution Control Federation, San Francisco, California; p. 37.

TITLE

Numerical Studies of Unsteady Flow in the James River

PROJECT DIRECTORS

J. M. Wiggert, Ph.D. — Department of Civil Engineering
D. N. Contractor, Ph.D. — Department of Civil Engineering

TERM

July 1, 1970 to September 30, 1971

SPONSOR

Office of Water Resources Research, U.S. Department of the Interior, Project A-036-VA

FUNDING

Office of Water Resources Research: \$8,305; VPI&SU: \$2,000

OBJECTIVES

The goals were to develop a computer program for numerical solutions of unsteady flows in a natural river channel, and to apply the program to various practical flow situations that are encountered in water resource work, e.g., flood flows, low flows, and flows in a pump-storage channel.

CONCLUSIONS

As illustrated by the following statements, the findings were diverse: (a) The implicit method of numerical solution of unsteady flow equations is ideally suited for natural river channels. (b) The Newton method of solution of nonlinear, algebraic simultaneous equations is general enough to be applied to this situations. (c) Flood flows in the James River were simulated satisfactorily despite incomplete data on tributary inflows and intermediate dams. (d) Low flows in the James River were simulated correctly only after the program was run in double precision and the correct roughness in the river was obtained by trial. (e) The Smith Mountain Pump Storage Project on the Roanoke River provided an opportunity to check the accuracy of the program when applied to a channel in which reverse flows occurred. The simulation was satisfactory and showed the applicability of the program to problems of long-wavelength motion in lakes, estuaries, and other closed basins.

RELEVANCE

This research shows that computer simulation of floods in rivers, long-wave motion in lakes, and other problems can be studied effectively and economically. Working physical models of such systems would be more expensive and time consuming.

TITLE

Assessment of Treatability of Waste Discharges from Radford Army Ammunition Plant.

PROJECT DIRECTORS

Clifford W. Randall, Ph.D. — Department of Civil Engineering
Paul H. King, Ph.D. — Department of Civil Engineering

TERM

August 13, 1970 to August 13, 1971

SPONSOR

Hercules Incorporated, Radford Army Ammunition Plant, Radford, Virginia

FUNDING

Sponsor: \$10,000

OBJECTIVES

The research sought to determine the appropriate treatment method for 12 major wastewater outfalls located at the Radford Army Ammunition Plant and to evaluate each wastewater and its primary components for susceptibility to physical, chemical, and biological treatment.

CONCLUSIONS

It was determined that munitions wastes, such as TNT isomers, nitroglycerin wastes, and solvent recovery wastes (ethyl alcohol, diethyl ether, and dinitrotoluene), can be treated biologically by various processes. The biological treatment of TNT wastes is extremely complicated and should be supplemented by physical processes, such as carbon adsorption.

RELEVANCE

This research has shown that typical biological waste treatment processes can be used to treat munitions wastes. The susceptibility of such wastes to biodegradation provides an economical approach to pollution abatement for munitions manufacturers.

PUBLICATIONS

Albert, R. C. (1971) Treatment of a Mixed Organic Waste Utilizing Attached Filamentous Microorganisms; M.S. Thesis; Department of Civil Engineering, Virginia Polytechnic Institute and State University.

Nay, Marshall W. (1971) A Biodegradability and Treatability Study of TNT Manufacturing Wastes with Activated Sludge Systems; Ph.D. Thesis; Department of Civil Engineering, Virginia Polytechnic Institute and State University.

Nay, Marshall W. and C. W. Randall (1971) "Biological Treatment of Munitions Wastes"; Abstract; Virginia Journal of Science; Vol. 22; p. 118.

TITLE

The Differential Use of Chironomidae and Ceratopogonidae (Diptera) in the Monitoring of Various Aquatic Wastes

PROJECT DIRECTOR

E. C. Turner, Jr., Ph.D. – Department of Entomology

TERM

July 1971 to June 1973

SPONSOR

Office of Water Resources Research, U.S. Department of the Interior, Project A-042-VA

FUNDING

Sponsor: \$9,385

OBJECTIVES

The study is designed to determine if certain species of aquatic Nematoceran insects are sensitive to types of pollution, to develop methods of rearing these insects, to evaluate various trapping and monitoring devices in streams, and to develop a training program in aquatic entomology for students interested in aquatic sciences.

CONCLUSIONS

Preliminary surveys have begun at locations of organic, thermal, and heavy metal pollution. Techniques for rapid recovery and rearing of certain dipterous insects are being developed and evaluated. The collected material is being added to a reference collection of aquatic Diptera. This synoptic collection will aid in the research and also in developing a training program in aquatic entomology.

RELEVANCE

An important objective of this research will be to find certain easily reared species of aquatic Diptera that can be used to detect, by simple bioassay processes, the presence or absence of certain forms of water pollution. Concurrent with the development of a research program will be the development of an aquatic entomology training program in the department. No such training program exists in the University at present. These programs will in turn aid in the development of other aquatic research programs in related departments.

TITLE

Evaluation of Stocking Channel Catfish and Smallmouth Bass Below the Celanese Plant, Narrows, Virginia

PROJECT DIRECTOR

Robert T. Lackey, Ph.D. — Department of Forestry and Wildlife Sciences

TERM

June 1971 to June 1973

SPONSOR

Celanese Corporation

FUNDING

Sponsor: \$10,992.50

OBJECTIVES

The objectives are to measure changes in the sport fishery and to measure growth and migration of the stocked fish in relation to the plant discharges.

CONCLUSIONS

The study is now incomplete.

RELEVANCE

This project is designed to evaluate the success, as measured by the increased sport catch and sampling, of a restocking program in a river receiving industrial discharges. Also, this program will study growth and migration of fish as influenced by the Celanese plant.

TITLE

Techniques for Measuring Public Evaluation of Recreation and Hydroelectric Water Use

PROJECT DIRECTOR

John A. Ballweg, Ph.D. – Department of Sociology

TERM

September 1, 1970 to June 30, 1971

SPONSOR

Office of Water Resources Research, U.S. Department of the Interior, Project A-038-VA

FUNDING

Sponsor: \$8,885

OBJECTIVES

The project was designed to explore the feasibility of using the Likert and semantic differential techniques for measuring public attitudes toward the allocation of water resources for recreational and hydroelectric purposes.

CONCLUSIONS

Responses to a 16 item Likert scale produced a reliability coefficient of .538. An examination of the Likert scale in relation to demographic characteristics of respondents suggested that persons with higher occupational and educational attainment were more negative toward water related questions than persons at the opposite end of the occupational and educational

continuum. A similar finding was noted for family income: as income increased, so did the proportion of negative responses. It was also found that younger respondents were more negative than older respondents. No noteworthy difference was detected in the response patterns for men compared with women.

For two semantic differential scales reliability coefficients of .84 and .87 were found. Four categories of respondents were established on the basis of responses above or below the sample mean. The categories were described as "recreation oriented," "power oriented," "negative orientation," or "positive orientation." A recreation orientation was more associated with younger respondents and persons with a higher family income. Power orientation was more characteristic of blue-collar workers, retired persons, and respondents with lower educational attainment. Women were generally more negatively oriented than men, while white-collar workers were over-represented in the category reflecting a positive orientation to both recreation and power. Findings suggest that the semantic differential can serve as a tool to isolate selected demographic characteristics associated with positive or negative views toward dual uses of a water resource.

PUBLICATIONS

Beasley, John J. (1971) A Study of Factors Associated with Semantic Differential Response Patterns; M.S. Thesis; Department of Sociology, Virginia Polytechnic Institute and State University.

TITLE

Analysis of Water Resource Administrative Agencies

PROJECT DIRECTOR

William R. Walker, J.D. — Water Resources Research Center

TERM

September 1969 to August 1972

SPONSOR

Office of Water Resources Research, U.S. Department of the Interior, Project B-025-VA

FUNDING

Office of Water Resources Research: \$14,242; VPI&SU: \$14,242

OBJECTIVES

This research will analyze and evaluate the various administrative agencies in the State of Virginia which are concerned with some aspect of water resource

management. This analysis will enable an assessment to be made of the operation of these agencies in terms of the water resources objectives of the State and will aid in the formulation of various administrative models best suited to accomplish these goals.

CONCLUSIONS

The research is not complete.

RELEVANCE

An important aspect of water management is the efficiency of the political structure responsible for this function. An understanding of the relationships between the various government agencies sharing water resources responsibilities and the decision-making processes involved is essential to an effective state program.

TITLE

Evaluation of Flood Insurance in a Disaster Area

PROJECT DIRECTOR

William R. Walker, J.D. — Water Resources Research Center

TERM

July 1970 to June 1973

SPONSOR

Office of Water Resources Research, U.S. Department of the Interior, Project B-030-VA

FUNDING

Office of Water Resources Research: \$24,322; VPI&SU: \$24,322

OBJECTIVES

This project will attempt to assess the potential effectiveness of the Federal Flood Insurance Program by estimating the impact that flood insurance might have had in a disaster area had the program been adopted by the community.

CONCLUSIONS

The research is not complete.

RELEVANCE

In 1969 Hurricane Camille caused severe flooding in many sections of Virginia. In addition to the losses sustained directly by the victims, all of the taxpayers of the State made substantial contributions to the relief effort through the various public relief agencies. The communities affected could

have qualified for flood insurance and, thus, shifted part of the cost of recovery to the victims and other risk takers. The findings of this research should indicate whether a voluntary or a compulsory insurance program for the occupancy of flood prone areas is necessary for "insurance" to be a viable alternate, whether modifications are needed in the existing insurance program, or whether the program should be abandoned before large investments of money have been made.

TITLE

Water Rights Doctrine as Limitations on Water Resources Development

PROJECT DIRECTOR

William R. Walker, J.D. — Water Resources Research Center

TERM

July 1971 to December 1973

SPONSOR

Office of Water Resources Research, U.S. Department of the Interior, Project B-040-VA

FUNDING

Office of Water Resources Research: \$25,570; VPI&SU: \$25,754

OBJECTIVES

This research will attempt to identify situations in which existing water laws frustrate needed water resource development and to propose modifications which will make existing laws more compatible with contemporary environmental thinking.

CONCLUSIONS

The research is not complete.

RELEVANCE

Existing water rights doctrine has, in many instances, been found to be in conflict with the most environmentally sound use of our water resources. For example, in some states inefficient use of water is encouraged because there is no reward associated with using less water than that to which the user is legally entitled. In fact, to protect his right, the user may feel compelled to consume his legal entitlement whether or not he has need for it. This study hopes to identify problem areas where state law holds the potential for frustrating development of water resources under present day conditions.

Washington and Lee University
Lexington, Virginia 24450

TITLE

An Investigation of the Metal Ion Content of the Maury River

PROJECT DIRECTOR

Michael A. Pleva, Ph.D. — Department of Chemistry

TERM

January 1971 —

SPONSOR

Washington and Lee University, R. E. Lee Undergraduate Research Program

OBJECTIVES

The main objective is to develop interest and participation by undergraduates in meaningful research programs. An investigation of metal ion levels in the Maury River is a natural choice for this kind of program.

CONCLUSIONS

Thus far, only tentative levels have been set for metal ion content. Since the main thrust of the program is to develop the research ability of undergraduates, specific values for metal ion content must be rechecked by further work. This will be the focus of future work.

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